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THE
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OF THE
United Service Institution,
WHITEHALL YARD.

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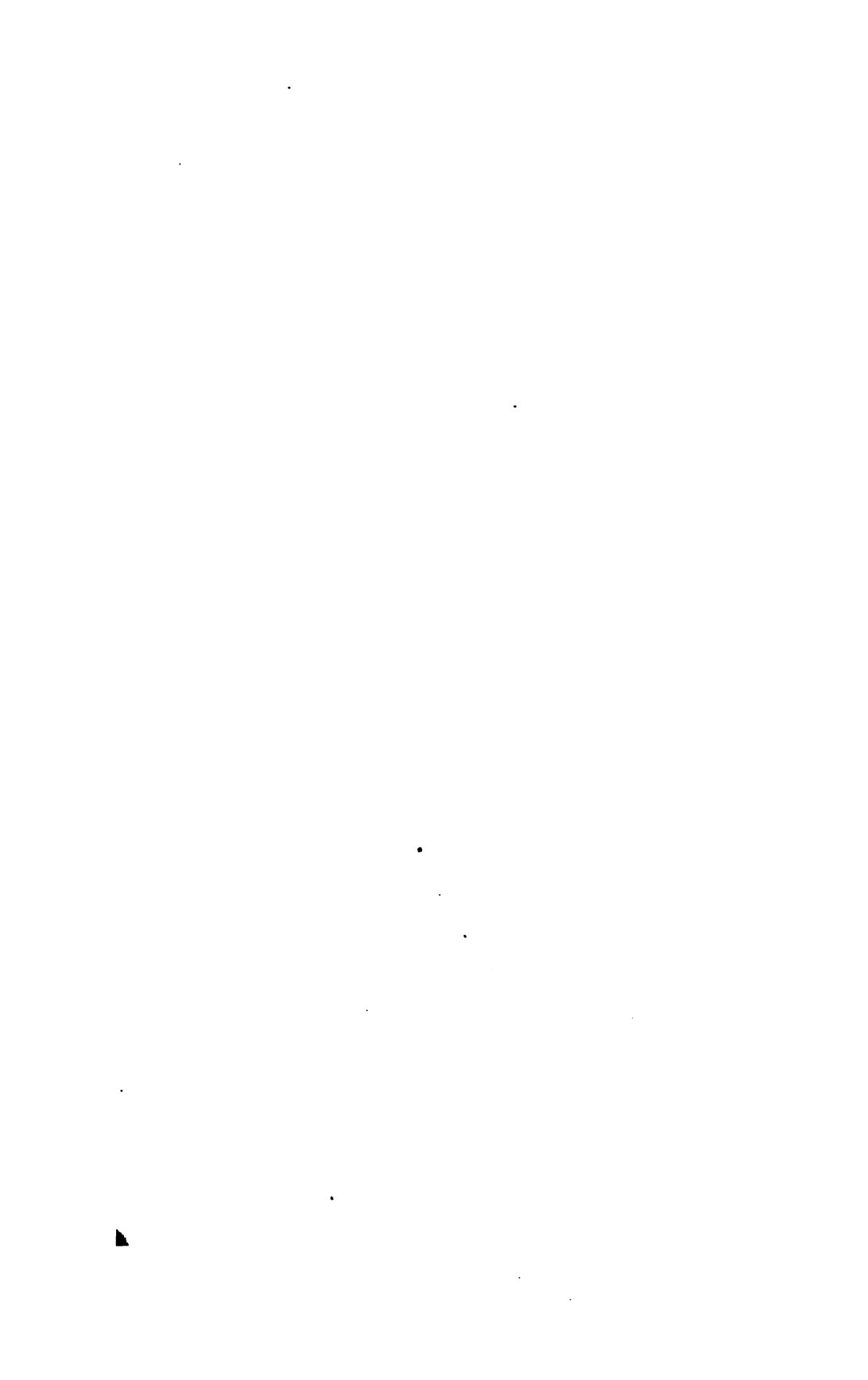
VOL. I.



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1858.



CONTENTS OF VOLUME THE FIRST.

	Page
Patrons, Vice-Patrons, President, and Officers, of the United Service Institution	iv
Laws of the Institution	v
Chairman's Address	1
Field Fortification. Captain LENDY, Practical Military Institute, Sunbury .	7
Persia and the Persians. Lt.-Col. Sir HENRY RAWLINSON, K.C.B. .	19
The Armies of Ancient Greece. The CHAPLAIN-GENERAL	30
China and the Chinese. J. CRAWFORD, Esq., F.R.G.S.	51
Military Surveying. Captain BAILLIE, 26th Bengal N. I.	61
The Model of Sevastopol, Memorandum on	75
Forms of Ships, with relation to Naval Gunnery. Captain FISHBOURNE, R.N.	78
Diagram of a Discovery with respect to Magnetism. Captain NOLLOTH, R.N.	93
The Rifle ; its Probable Influence on Modern Warfare. Lt.-Col. DIXON, R.A.	95
Small Arm Factory, Enfield	95
The Genius and Campaigns of Hannibal. Lt.-Col. MACDOUGAL, R. M. Col.	120
The Political, Military, and Commercial Importance of the Euphrates Route to India. Major-General CHESNEY, R.A., F.R.G.S., &c.	147
The Molecular Constitution of the Metals of Ordnance, as affecting its Construction and Wear. ROBERT MALLET, Esq., C.E., F.R.S., &c.	167
The Military Roads of the Ancient Romans, compared with Modern British Railways. Rev. R. BURGESS, B.D.	207
Application of the Principles of Medical Geography to the Preservation of the Health of Soldiers and Seamen. Dr. BIRD, F.R.G.S.	221
The Rifle ; and Necessity for its Introduction as an Universal Infantry Weapon. Lt.-Col. WILFORD, School of Musketry	238
On Military Tactics. Lieut. D. C. WALKER R.E.	253
The Regimental Schools of the French Army. MONTAGUE GORE, Esq.	269
Proceedings of the Twenty-seventh Anniversary Meeting, March 6th, 1858 ; and Annual Report for 1857	283
Address of the Right Hon. SIDNEY HERBERT, M.P., Vice-Patron	301
Proceedings of the Special General Meeting, January 4, 1858	304
Statement of Changes amongst the Members during 1857	308
Tabular Analysis of the State of the Institution to 31st December, 1857	308
New Members during 1857	59, 78, 166, 268, 278, 312
Members paying Increased Subscriptions during 1857	60, 166, 268, 278, 309
Presents Received	60, 78, 166, 269, 279, 313
Donations	310
Subscribers to the Model of Sevastopol	311

UNITED SERVICE INSTITUTION.

PATRONS.

HER MAJESTY THE QUEEN.

FIELD MARSHAL HIS ROYAL HIGHNESS THE PRINCE CONSORT.

VICE-PATRONS.

GENERAL H.R.H. THE DUKE OF CAMBRIDGE, K.G. &c. &c.

FIELD MARSHAL HIS MAJESTY THE KING OF THE BELGIANS, K.G. &c. &c.

Wood, Rt. Hon. Sir Charles, Bart. M.P.	Holdsworth, Col. A. H. Yeom. Cav.
Pannure, Rt. Hon. Lord.	Graham, Rt. Hon. Sir James, Bart. M.P.
Northumberland, Rear-Admiral His Grace the Duke of, K.G. F.R.S. &c.	Broughton, the Right Hon. Lord, G.C.B.
Stratford, Field Marshal Right Hon. the Earl of, G.C.B. G.C.H.	Baring, Rt. Hon. Sir Francis T. Bart. M.P.
Brisbane, General Sir Thomas M. Bart. G.C.B. G.C.H. LL.D.	Beresford, Rt. Hon. W. M.P.
Douglas, General Sir Howard, Bt. G.C.B. G.G.C.M.	Murchison, Sir Roderic I. G.C.St.S. F.R.S. &c.
Sykes, W. H. Colonel Bombay Army, F.R.S. M.P.	Norfolk, His Grace the Duke of, late of the Royal Horse Guards.
Richmond, Colonel His Grace the Duke of.	Herbert, Rt. Hon. Sidney, M.P.
Hardwicke, Rear-Adm. the Right Hon. the Earl of, R.N.	Peel, Major-General Rt. Hon. J. M.P. Secretary for War.
	Pakington, Rt. Hon. Sir John, Bart. M.P. First Lord of the Admiralty.

TRUSTEES.

Rear-Admiral His Grace the Duke of Northumberland, K.G. F.R.S. &c.
His Grace the Duke of Norfolk, &c. &c.

Colonel A. H. Holdsworth, Yeom. Cavalry, Governor of Dartmouth.

PRESIDENT.

THE DUKE OF NORTHUMBERLAND, K.G. &c. &c.

VICE-PRESIDENTS.

Smyth, W. H. Rear-Admiral, K.F.M. F.R.S. F.S.A. F.R.G.S. D.C.L. &c.	Lindsay, Hon. James, Colonel Grenadier Guards.
Fox, C. R. Lieut.-General.	Pollock, Sir G. Lieut.-Gen., Bengal Army, G.C.B.
Stanhope, P. Spencer, Major-General.	Hamilton, F. W. Colonel Grenadier Guards, C.B.
Back, Sir George, Rear-Admiral D.C.L. F.R.S. &c.	Herbert, Sir Thomas, K.C.B. Vice-Adm.
Yorke, P. J. Colonel, Hereford Mil. F.R.S. &c.	Alcock, T. St. Leger, Lieut.-Col. R. E. Mid. Mil.
Raper, H. Lieut. R.N. F.R.A.S. &c.	Ford, John, Capt. Royal Hosp. Chelsea.

COUNCIL.

1857.

CHAIRMAN—Colonel the Hon. James Lindsay.

VICE-CHAIRMAN—Vice-Admiral Sir Thomas Herbert, K.C.B.

Packe, E. Captain, late Royal Horse Guards.	Howes, George, Commander R.N.
Fishbourne, E. G. Captain, R.N.	White, Lorraine, Major.
Sweny, M. H. Captain, R.N.	Smith, T. Charlton, Colonel, Unatt.
Jefferson, R. Capt. h.p. Ceylon Rifle Regt.	Matheson, Thomas, Colonel, Unatt.
Edwards, Peter, Colonel, Unatt.	Nolloth, Capt. M. S. R.N.
Codrington, H. J. Rear-Admiral R.N. C.B.	Hogg, Lt.-Col. 1st Life Guards.
Jervoise, W.F.D. Major, R.E.	Grant, Capt. late R.A.
Dunne, F. F. Lt.-Col. Unatt.	Williams, Maj.-Gen. Sir Fenwick, Bart. R.A.
Lacon, W. Stirling, Esq. late H.E.I.C.S.	Adair, Col. Shafto, Suffolk Mil. Art.
Lefroy, J. H. Lt.-Col. R.A.	Fowke, Capt. R.E.
Gleig, Rev. G. R. Chaplain-Gen. to the Forces.	Stuart, Lt.-Col. J. P. D. C. Gren. Guards, M.P.
Tupper, A. C. Capt. Royal Middlesex Rifles.	Collinson, R. Capt. R.N. C.B.

SECRETARY—Captain Boughy Burgess, E.I.C.S.

L A W S.

SECTION I.—DESIGN.

1. THE UNITED SERVICE INSTITUTION is founded as a central Repository for objects of Professional Art, Science, and Natural History, and for Books and Documents relating to those studies, or of general information. The delivery of Lectures on appropriate subjects is included in the design of the Institution.

SECTION II.—COMPOSITION.

1. The Members shall consist of Princes of the Blood-Royal; Officers of the Navy, Army, Marines, Regular and Local Militia, East India Company's Land and Sea Services; Lords Lieutenants and Deputy Lieutenants of Counties; Yeomanry; all persons who may have retired from any of the above services or capacities; Civil Functionaries, who are or have been attached to the Naval and Military departments; and Navy and Army Agents.

2. Gentlemen above the age of Fifteen, whose names are on the list of the Commander-in-Chief for commissions in the Army, and who are recommended by two Members of the Institution on their personal knowledge, shall be admissible to become PROVISIONAL MEMBERS of the Institution, from year to year, under the regulations of Section IV., on payment of the Annual Subscription; such Provisional Members, on obtaining their commissions, becoming Ordinary Members on payment of the Entrance Fee.

SECTION III.—GOVERNMENT.

1. There shall be Patrons and Vice-Patrons.
2. The following Public Officers shall be invited to hold the office of Vice-Patron *ex officio*.

The First Lord of the Admiralty.
The Commander-in-Chief of the Forces.
The Vice-Admiral of the United Kingdom.
The Lord Lieutenant of Ireland.
The Master-General of Ordnance.
The Secretary-at-War.
The Chairman of the Court of Directors of the H. E. I. Company.
The Deputy-Chairman of the Court of Directors of the H. E. I. Company.
The Director-General of Military Hospitals.
The Director-General of the Ordnance Medical Department.
The Inspector-General of Naval Hospitals.

3. There shall be a President and twelve Vice-Presidents.
4. The Officers of the Institution shall consist of
A Secretary and Curator.
5. Twenty-four Members shall constitute a Council of Management.

6. Eight Members of the Council shall annually go out by rotation. The Council shall submit to the Annual General Meeting a list of names, from which the vacancies may be filled. Three of the Members going out shall be eligible to be re-elected.

7. The Vice-Patrons to be Honorary Members of the Council.

8. The President and Vice-Presidents to be *ex-officio* Members of the Council; and the President, or senior Vice-President, to preside at its meetings.

9. Two Vice-Presidents to undertake, monthly, the office of Visitors, to inspect the Institution and its affairs, making a report thereof to the Council.

SECTION IV.—CANDIDATES LIABLE TO BE BALLOTTED FOR.

1. Retired Officers, civil functionaries, and candidates for commissions, referred to in Section II., and Navy and Army Agents, shall be submitted for election to the Council of Management, specially assembled.

2. A List of such Candidates, signed by the Secretary, shall be put up in the Library, fourteen days previous to the ballot.

SECTION V.—HONORARY MEMBERS.

1. Foreigners of Distinction may be admitted Honorary and Corresponding Members.

2. Eminent Individuals and Benefactors to the Institution, not otherwise eligible, may be admitted Honorary Members at the discretion of the Council, on specific grounds.

3. The Corps Diplomatique shall be invited to become Honorary Members; and shall be privileged to submit the names of foreign noblemen and gentlemen, resident in England, to the Council, in order that the same courtesy may be extended to them, for the space of Three Months: this privilege to be renewed to such strangers, if desired, on the written application of their respective Ambassadors, or at the recommendation of some Member to whom they may be personally known.

4. Foreign Naval and Military Officers may be admitted Corresponding Members.

5. Ladies who contribute to the Institution may be admitted Honorary Members, at the discretion of the Council.

SECTION VI.—SUBSCRIPTIONS.

1. An entrance fee of ONE POUND shall be paid by all Members on joining the Institution.

2. The Annual Subscription shall be not less than TEN SHILLINGS, due on the 1st of January.

3. The payment of the sum of not less than SIX POUNDS, in addition to the Entrance Fee, shall constitute a Member for Life.

4. Any Member failing to pay his annual subscription for two successive years, shall cease to be a Member, unless the Council should see reason to decide otherwise.

5. Members withdrawing from the Institution, re-admissible only on payment of arrears, unless the Council should see reason to decide otherwise.

SECTION VII.—MODE OF VOTING.

On all questions to be decided by Vote, the mode of voting shall be by Ballot.

SECTION VIII.—GENERAL MANAGEMENT.

1. The affairs of the Institution shall be conducted by the Council of Management; who shall be empowered to make such Regulations, consistent with the fundamental Laws, as they may from time to time deem necessary.

2. Five Members of the Council shall constitute a Quorum.

SECTION IX.—FUNDS AND EXPENDITURE.

1. The Management of the property, receipts, and payments of the Institution shall be confided to the Council, who will authorise every payment by an order, signed by the Chairman of the Meeting, and another Member of Council present, and countersigned by the Secretary.

2. That the United Service Institution neither shall nor may make any dividend, gift, division, or bonus in money, unto or between any of its Members, out of its present property, or out of any property which it may hereafter acquire, and that the whole of its property, both present and future, shall be exclusively applied for carrying into effect its design as a central Repository for objects of Professional Art, Science, and Natural History, and for Books and Documents relating to those studies, or of general information, and likewise for the delivery of Lectures on appropriate subjects.

SECTION X.—TRUSTEES AND AUDITORS.

1. There shall be three Trustees, appointed at a Special Meeting, in whose name all securities shall be taken, Government or other public funds be bought or sold, and purchases and investments made of all sums of money, which there shall not be present occasion for expending, or otherwise disposing of, for the use of the Institution.

2. The matter of such trust, however, to be subject to the control of the Council of Management,—and the Orders in writing of the Chairman then presiding at a Board assembled, countersigned by the Secretary, shall be obligatory upon, and a justification of, the Trustees, as to any such purchase, sale, investment, or disposal.

3. Auditors, not Members of the Council, shall be named at each Annual Meeting to audit the accounts of the year next ensuing.

4. As soon after the Audit as may be, and fourteen days before the

Annual Meeting, the Council shall cause an abstract of the Accounts of the Institution of the current year, and an estimate of the probable expenses of the ensuing year, to be laid upon the Library table, for the inspection of the Members.

SECTION XI.—GENERAL MEETINGS.

1. A General Meeting shall be annually held on the first Saturday in March ; that day being considered the Anniversary of the Institution.

2. The Council of Management may call a General Meeting on giving fourteen days' notice,—which notice must be suspended in the Public Rooms or Library, specifying the object or objects in contemplation, and explicitly stating that the discussion shall be strictly confined to those objects.

3. The Council shall call a General Meeting, on the written requisition of Fifty Members, subject to notices and restrictions similar to the preceding.

4. All notices of such Meetings, called by the Council, must be signed by at least Five of its Members.

SECTION XII.—MAKING OR REPEALING LAWS.

Should it be proposed to make or repeal a fundamental Law, the proposition to such effect, signed by the proposer and seconder, shall be suspended for fourteen days in the Library ; the question to be then determined at the next General Meeting, by a majority of at least two-thirds of the Members present.

SECTION XIII.—CONTRIBUTIONS.

The name of each Contributor shall be recorded, with a specification of the gift.

SECTION XIV.—HOURS OF RECEPTION—VISITORS.

1. The Rooms of the Institution shall be open daily (Sundays excepted), from eleven o'clock in the morning until five in Summer, and four in Winter ;*—the Library alone being kept open for the use of the Members till eight in the evening, during the whole year, Fridays excepted, on which day the Museum will be closed to visitors.

2. Members to have the privilege of introducing visitors to all the rooms except the Library, first inscribing the names of such visitors in a book to be kept for that purpose.

SECTION XV.—EXPULSION.

1. Any officer who may quit the service from causes affecting his character as a gentleman, shall cease to belong to the Institution.

2. Any Member who shall wilfully and pertinaciously contravene the Regulations,—or who shall advisedly do anything to the injury or dishonour of the Institution, shall be liable to expulsion.

* Winter months—October to March, inclusive.

THE
Journal
OF THE
United Service Institution.

VOL. I.

1857.

No. I.

ADDRESS

Delivered on Monday, 18th May, 1857, by COLONEL THE
HON. JAMES LINDSAY, Chairman.

GENTLEMEN,

IN commencing our Course of Lectures and Evening Meetings for this year, I hope you will permit me before we begin to make a few observations to you upon the state and prospects of this Institution.

I will first allude to the financial position. You will recollect that about five years ago, after we had spent the greater portion of our capital in building a Lecture Theatre and in improving the accommodation of the Institution, and were in fact for the first time in a position to carry into effect its original design, we were suddenly surprised by a demand on the part of the parish for poor's and other rates from which we had hitherto been exempt. Against this claim we appealed, but by an unexpected and adverse decision of the Court of Queen's Bench, we were burthened with an increased expenditure of 130*l.* a-year. This entirely paralysed our action, and made a demand upon our resources which we have been as yet unable to meet.

The effect has been that, for the last five years, with the exception of 1853, the ordinary expenditure has exceeded the ordinary income. You are aware that by the rule and practice of the Institution all Life Subscriptions must be funded, as being the capital of the Institution; this being the course not only due to those who compound for Life, but a practice dictated by policy and prudence. We have been unable to continue this course of action, and are now in debt to our capital upwards of 200*l*. But this is not all. For the last ten years we have had to pay a rent of 200*l*. a-year to the Crown, which with other charges amount to no less than 430*l*. a-year, being equal to one-third of the ordinary income, and to the subscription of 860 members. It is unnecessary for me to trouble you with any remarks upon the sort of almost checkmate such a burden imposed. Though our position may be at present unsatisfactory, yet there is hope in the future; for after years of perseverance we have at last succeeded in obtaining the countenance of the Government, who, though unable to remit the charges we have to pay, have proposed to give us a sum with which to pay them. This will restore us to that position we were in ten years ago, but with this drawback, that, whereas our income from annual subscriptions was about 1,400*l*. a-year, it has now fallen to 1,200*l*. a-year.

I must now draw your attention to what must be admitted—that we do not enjoy that hearty support which an institution of this description ought to receive from the officers of both army and navy. The subscription of ten shillings a-year is so insignificant that it is impossible to suppose for one moment that it deters many from becoming members. We must therefore look to those natural causes which to some extent govern men. The two services (and in the military I include the East India, Militia, and Yeomanry services) are composed of officers who are serving their country in different localities—some in remote stations at home, others in distant colonies. To give an institution of this description any chance of success, it must be in London, where all facilities and appliances

exist to bring it to the highest amount of perfection. At the same time, it is evident that even those officers who are serving at home only visit London occasionally, and when they do, they have probably engagements which during the short time they are here present greater attractions than this Institution can afford. It must also be remarked that during the last few years the officers of the army have considerably changed. The greater portion of the officers have entered the service during the time the Institution has been unable to exert itself, and have therefore little or no knowledge of its existence, character, or object. This is no doubt to be ascribed to the resources of the Institution not permitting that extensive printing, advertising, and circulation, which would keep it prominently before the services: these causes and the effect of the late war have at any rate produced the following results, shewing a considerable falling off in the officers on full-pay since 1844; as the table which I now hold in my hand will show.

	1844.	1857.
Household Cavalry	24	49
Cavalry	129	69
Artillery	167	94
Engineers	123	84
Guards	140	226
Line	584	189
Navy, all ranks	845	556
East Indian Service	165	151

So that, except in the Household Cavalry and Infantry, from whom a unanimous support may naturally be expected in consequence of their station in the metropolis, there has been a large decrease of members.

It is evident that we must seriously consider in what manner we must recruit our numbers, for on numbers, from the smallness of the subscription, we must rely. It is only reasonable to suppose that there is a certain class of officers of ample means, who, if they were aware of our requirements and were con-

vinced that the Institution deserved professional support, would from professional *esprit* and pride give their assistance. But there is another and the larger number who with reason urge that the Institution is of no immediate benefit to them, and consequently they are unwilling to subscribe to it. I hope the time is approaching when we may not only increase our numbers from a feeling that officers are supporting an Institution which the services ought to be proud to call their own, but that we shall be able to give our absent members something in return for their subscriptions, and keep them acquainted with all that goes on within our walls. The income set free by relief from taxation will enable us to print and circulate a Journal of our Proceedings. And here let me say, that I conceive nothing could be more fatal to our interests than to rely upon anything else than our own exertions, and the voluntary support of officers. Beneficial as the relief expected may be, if our numbers become reduced, we should soon be no better off than we have hitherto been. Our course must be, not only to maintain our present strength, which requires recruiting for the supply of vacancies to the number of 140 a-year, but to increase this number largely, and we require not less than 500 new members to place the Institution in that position which can render it thoroughly effective.

I will now say a few words as to the course we propose to pursue to raise the position of the Institution. All other professions have establishments for imparting professional knowledge and general information. In the learned and scientific societies of the country, naval and military science has been hitherto unrepresented and unrecognised; it is the province of this Institution to fill that vacancy and become to the services what the museum in Jermyn Street is to geology, and that of Kew to botany. We have among our members officers of the highest talent and ability, eminently capable of imparting the knowledge they have acquired, and of giving the service the benefit of their experience. The professional papers of the Royal Engineers are of the highest

order, and amply prove what I say. We hope to obtain the service of distinguished officers for our Lectures, and already I am glad to say that Colonel Dixon of the Royal Artillery, Colonel Wilford of the Hythe establishment, the Chaplain-General, and Colonel Macdougall of the Sandhurst College have granted their services. We propose also to continue meetings for the purpose of discussing professional and scientific questions, and to encourage inventors to exhibit and explain such inventions as have connection with the professions. It must also be remarked that articles of warlike character are placed for exhibition in the Society of Arts, whereas, if this Institution held the place in a professional light which it ought to do, such articles should be exhibited here. It will be the duty of the Council to provide the means of facilitating such exhibitions. In the Journal of Proceedings we propose to print the lectures, or an abstract of the lectures, and the discussions which take place. The numbers will be issued three or four times a year, and sent to all members serving in other parts of the country and in the Colonies. They will contain every information connected with the Institution—the new members; a list of donations and presents; and we shall form two scientific Committees, one Naval, the other Military, for the purpose of assisting the Council in all questions relating to science.

In this manner we hope, by giving officers a *quid pro quo*, by making the Institution practically useful, by promoting and encouraging information which must be beneficial, to obtain the hearty concurrence of the officers of the several services—a course which, we trust, will not only raise the character of the Institution, but the character of those who compose it.

In pursuance of the plan detailed, we propose to send an address to the officers of the several services, detailing our objects and requesting their support. We have received an expression of cordial good-will from many general officers of districts, and from many of our members in different stations. Though for reasons already expressed we may not be so successful as we would wish, yet the address will have the effect of im-

pressing our designs upon the officers and makethem acquainted with the merits and objects of the establishment.

We have also reason to hope that we may receive support from the collateral services of the Yeomanry and Militia. In these two services there exists considerable military *esprit*, and a great anxiety to assist the welfare of military Institutions. Several of the most zealous of their officers—Colonel Adair, Colonel Gilpin, and Colonel Smyth—have recently joined the Institution; while the late Speaker of the House of Commons, one of the most distinguished commanders of Yeomanry corps, became one of our life-members last year.

Upon the whole we have every reason to be sanguine for the future, and that we have passed the most difficult period of our career; and I trust it will be the pleasing duty of the future Chairman of the Council, in opening the lecture season, to congratulate you upon the successful progress of professional science, as developed by the proceedings of this Institution.

Gentlemen, before I sit down, I cannot help drawing your attention to the loss which we sustained a few days ago, by the death of Lord Radstock. He fulfilled the duties of Chairman of the Council of this Institution upon two occasions, and every one who was acquainted with him must bear testimony to the kindness of his disposition, and the high character which he bore, not only as a naval officer, but as a person who in his sphere of life was noted for every charitable and benevolent action. He was one of our Vice-Presidents also, and it is a loss which we most deeply deplore.

We have also to regret the loss we have sustained by the death of our Secretary. As you all know, Mr. Tonna had for some years been in a declining state of health which almost incapacitated him from work—in fact we may say that we have been without a secretary for some time. He devoted the best part of his earlier life to the Institution. He was a man of very considerable acquirements, and, previous to his long illness, the Institution derived great benefit from his attention and abilities. He died a month ago, and it became our duty

to fill up his place, and I have now to introduce to you Captain Burgess, who is now on my right hand, whom the Council at the last meeting elected to act as Secretary and Curator to this Institution. I must say that the Committee which had to investigate the testimonials produced upon that occasion were perfectly satisfied of his qualifications to act in that capacity, and from what I have seen of Captain Burgess since he has been here, I am sure that he has anxiously devoted himself to the benefit of the Institution, and I feel certain that the members of the Institution will cordially coincide with the Council in the choice which they have made.

LECTURES.

Fridays, May 1 and 8, 1857.

COLONEL THE HON. JAMES LINDSAY in the Chair.

ON FIELD FORTIFICATION.

By CAPTAIN LENDY, late of the French Staff, Director of the Military Institute of Sunbury.

It ought never to be lost sight of that in every description of warfare fortification is only an accessory, destined to increase the power of resistance of troops; and that works, particularly in the field, are only resorted to when we are weaker than our adversary. Fortification should not, therefore, paralyse the action of the troops, *as has too often been the case*, but give full scope to their efficacy.

Cavalry can only act offensively; infantry and artillery can act both on the offensive and the defensive, and for the latter alone is fortification employed. It should at the same time protect them, and enable them to concentrate their fire so as to give it its fullest effect, conditions concisely expressed by a celebrated engineer, "It must *cover and flank*." To these we might add, it must also *make the*

most of the ground, for, in fortification more still than in tactics, it is true that bravery is worth more than numbers, but the nature of the ground is often of more use than bravery.

The study of topography is therefore the necessary complement of that of fortification, and, to obtain good results, both sciences should be learned simultaneously.

The attack of fortifications is also entrusted to infantry and cavalry alone.

We sometimes hear of cavalry storming field-works. This is wrong. Cavalry cannot storm a work; but it may turn it, and when the gorge is not defended by palisades, barriers, &c., it can rush on the garrison, and become master of the intrenchment. At the battle of Borodino (1812), the French cavalry thus took the Russian redoubts. A similar occurrence had taken place in 1760, near Weissen-Hirsch, when the Austrians were marching to the relief of Dresden.

Every one will readily understand the destination of the various parts of a work, the ditch, the parapet, the glacis, &c., and even calculate the dimensions of profiles. The nature and value of the different obstacles, such as palisades, chevaux-de-frise, &c., as well as the employment of artillery, will not long remain a mystery to the student. There will be no difficulty in remembering the different names given to the various tracings, and in appreciating the defects of undefended and dead angles on one hand, and the advantages of cross and flanking fire on the other; but what is not easily learnt is the application of these tracings to varied ground, so as to derive the greater protection and advantage from a limited amount of labour and time. Every other question of fortification sinks almost into insignificance before the "selection of a proper outline;" it implies both experience and ingenuity, and it is there that fortification is no longer a civilian's but a soldier's science. For the attack, this intimate knowledge of the ground, blended with that of the tracings, are again the chief requisites of a good engineer.

In selecting an outline, it is obvious that the ground is the first element to be considered, but it is not the only one: we must also bear in mind the end for which the work is designed, and the force of the garrison destined for its defence. Again, the amount of

labour, and the time required to throw up the work, may further induce us to modify this outline.

With regard to the ground, and the purpose of the work, no absolute rule can be laid down; here all is left to the ingenuity of the officer, and none should ever forget that it is not by difficult and complicated tracings that he will display his skill.

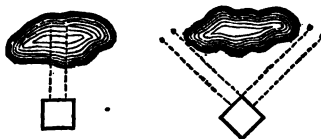
If a bridge thrown across a river is to be defended by a work, the figure shows that a redan would not answer the purpose if the river ran in a straight line; the assailant being in fact unexposed in his approach on the ground *A* and *B*; this outline would, on the



contrary, be good when the river presents sinuosities; the lunette should be preferred on the first supposition.

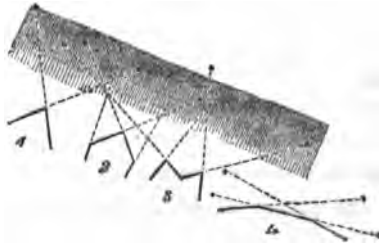


If a marsh or ground impassable to the enemy is in the vicinity of a position, it would be absurd to place a face parallel to the obstacle, since its fire would be lost; on the contrary, in directing a salient towards it, we at once obviate the want of fire on the capital.

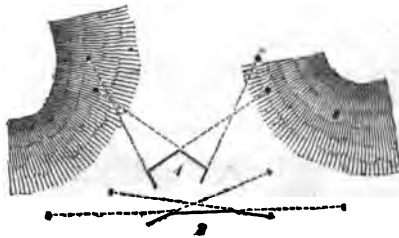


If a work must be thrown up close to a commanding height, the

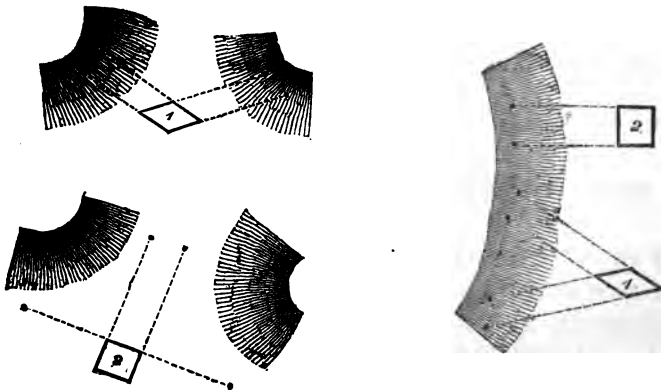
outlines 1, 2, 3, would give faces exposed to enfilade and reverse fire; the outline 4 should be preferred.



If the work is to be constructed in a valley between two commanding heights, outline 1 would again be absurd, so would be any other but figure 2.



Again the redoubt 1 has all its faces exposed to enfilade and reverse fire, while redoubt 2 has better conditions.



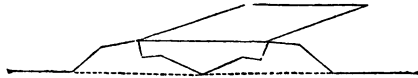
Examples of this kind could be multiplied *ad infinitum*, but a perusal of former campaigns is the best exercise that can be recommended to an officer desirous, in time of peace, of acquiring information, if not experience, on this delicate subject.

To fix the strength of a *garrison*, it is usual to compute two men for every yard of the crest of the parapet in open works, thus:—a redan destined for eighty men should have forty yards of parapet. Besides the men stationed on the banquette, a reserve is placed on the terreplein; it is generally a third of the whole garrison.

If a lunette having ninety yards of parapet is to be garrisoned, the detachment should muster 270—180 on the banquette, 90 forming reserves.

If two files of men be judged necessary for a good defence, the garrison should be calculated in the same manner: 360 for the banquette, 180 for the reserves. The same data will serve for lines; but, as these are defended by numerous armies, the calculation need not be very exact, inasmuch as there is a sufficient number of men to line the banquette in one, two, or three files.

When the work is an inclosed one, the terreplein must afford sufficient accommodation to the defenders for bivouacking, and its surface must enter into this calculation, fifteen square feet being allowed for every man. The dimensions of inclosed works are determined from this condition. Let us suppose a square redoubt. It is clear that the distance between the crest and the terreplein being four yards (about), a square redoubt with faces equal to eight yards would have no terreplein, and could not therefore be occupied.



In increasing the dimensions of the faces, the surface of the terreplein increases rapidly, and the length of the face can be calculated so as to give sufficient surface for its garrison. In supposing one man per yard of parapet, and no reserve, it is found that the smallest square redoubt would have fifty-eight feet for side, and 77 men for garrison. But a work of this description is also impossible: the terreplein would be so crowded, that room would not even be left for the fall of a shell.

To obtain a work giving sufficient accommodation, it is necessary to count a reserve of one third, and a minimum redoubt is obtained, fit for occupation. With two men per yard, or three, the minimum can be found.

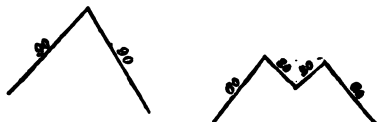
In making this calculation, when artillery is employed, it must be borne in mind that a gun takes 15 feet of parapet, and requires from 400 to 600 square feet of the terreplein. About 500 feet are, besides, taken by the mask of earth (traverse), usually constructed in these inclosed works to mask the passage left for the entrance and egress of the garrison. By the same consideration, the minima of pentagonal or hexagonal redoubts would be found.



As for Star Forts and Bastioned Forts, there is no need of making such calculation for them, because there is always more interior space inclosed than is required for the garrison.

The minimum of such works is obtained from other considerations. For Star Forts, the faces should not be less than 30 yards, to avoid dead angles, which gives 360 yards of parapet for 6 salients and 1080 garrison; 480 yards for 8 salients and 1440 men; and for Bastioned Forts the length of the smallest fronts has been shown to be equal to 200 yards. The perimeter of a square fort with perpendicular $\frac{1}{4}$ th. and face $\frac{1}{4}$ th is equal to 920 yards, and has a garrison of 2760 men.

The force of a detachment being known, the perimeter of an open work calculated on the base above-mentioned, $\frac{1}{3}$ rd of the force ($\frac{2}{3}$ rds for the banquette, $\frac{1}{3}$ rd for the reserve), the choice of the outline will depend upon the amount of labour and the intrinsic value of the work. Thus, instead of a redan, having a development of parapet of 180 yards, and faces of 90 yards, a double redan would be better.



In the same manner, instead of throwing up a redoubt of 360 yards perimeter, a Star Fort should be constructed, since its defence is better, and the amount of labour the same. Again, to a Star Fort of 920 yards parapet, a Bastioned Fort should be preferred.

After the selection of a proper outline, the chief point to which an officer ought to direct his attention is the execution of the work itself. A work, however good on paper, is not a work until it is altogether executed and ready for use. Here again "practice" is the only book to be studied on this important subject.

Field-works are often thrown up in a great hurry, and care must be taken not to begin a work unless there is a certainty of having it completed in due time. The following data will serve as a basis, in supposing the number of men employed on the déblai to be the greatest possible:—

A work of 8 ft. relief, with parapet 9 ft. thick, requires 8 days.

"	7 ft.	"	7 ft.	"	6 "
"	6½ ft.	"	6 ft.	"	4 "
"	6 ft.	"	4 ft.	"	2 "

To obtain approximately the time required for a work of greater relief, multiply the thickness of the parapet by that of the relief, expressed in yards; the product gives the number of days. A work ten feet high, with a parapet twelve feet thick, will then require about $3.3 \times 4 = 13.2$, between thirteen and fourteen days. In urgent cases, this time may be reduced by half in excavating on both sides.



It is not always possible in the field to throw up works with accuracy. The chief of a detachment, when receiving news of the arrival of the enemy, cannot waste time in calculations, but he sets his men to work at once, and makes them excavate a trench that will give a cover, which, time permitting, is afterwards converted into a regular breast-work. Tools may be wanting, then recourse is had to such accidents as the ground may present. It would require volumes to enter into the never ending details of the peculiar circumstances in which the vicissitudes of war may place an officer. If he be well acquainted with the spirit of fortification, it matters but little if he cannot recollect figures and dimensions; his sagacity will suggest what is best to be done.

It is needless to tell him that if he has to defend a village against

an enemy having artillery, he must remove the thatch from the roofs, barricade the streets, &c.

A mere wall will become for him a good cover.

A hedge, with little trouble, will be transformed into a breast-work.

The slope of a hill, by merely cutting down the inequalities it presents (an operation called *scarping*), will render his position difficult of access.

The more one investigates this subject, the more convinced one becomes that military history is the best complement of all military sciences. There indeed we see that much can be done with little means.

In India sun-dried bricks, mud, and even tiers of camel saddles have served to construct intrenchments. At Paris paving-stones have answered the same purpose. At the attack of Edinburgh (1688), at Fort San Christoval (1810), at Burthpoor (1825), in America, &c., cotton bales and wool packs proved of great advantage. At Lisbon (1810) *scarping* was employed on a large scale. At San Sebastian (1812) a redoubt was erected with casks to support the trenches of attack on the isthmus, &c.

A garrison in the defence of a fortress is often, if not always, obliged to have recourse to field-works.

When ravelins and bastions have been breached, permanent fortification has fulfilled its part, and the defence of the breaches may be considered as a branch of field fortification. It is indeed the most important item of the defence, and military history proves that a determined garrison can, by skilful dispositions, fight at a very great advantage at that critical period.

When the Constable of Bourbon had ruined the ramparts of Marseilles in 1544, the breaches were so skilfully and gallantly defended, that the Imperialists were compelled to raise the siege.

At Maestricht, in 1676, a French garrison of 6,000 men so vigorously fought for the defence of the breaches, that the Prince of Orange was obliged to give up any further attempt, and to retire with a loss of 12,000 men.

The breaches of Turin (1706) were defended by large fires, and successfully too.

St. Jean d'Acre was besieged in 1799 by Napoleon, and, although

the ramparts had been overthrown, all assaults proved unsuccessful, and the French had to retire, leaving their guns behind them.

In many other instances the Turks have given us a good example to follow, especially in the Russian campaign of 1828.

At Badajoz, in 1811, the English were repulsed at every assault. In 1812, the same place again resisted, and if General Picton had not surprised the Castle of San Christoval, the vigorous defence of the breaches would again have saved the place.

Even when the besiegers have gained a footing in a fortress, all hope of further resistance is not lost.

Prince Eugene at Cremona was obliged to retreat; so were the English at Berg-op-Zoom. At Saragossa, in 1809, the French had to besiege almost every house.

Fortification, it cannot be repeated too often, is only an accessory: the best work is a solid regiment, the best fortress a good army. The defensive in war is to be avoided. When therefore art is employed to increase the power of resistance of troops, it should be so contrived as to enable the defenders to assume the offensive when a favourable opportunity presents itself. Continuous tracings should be carefully avoided, and preference given to lines with intervals.

During the seventeenth and even the eighteenth century, continued lines were frequently employed to cover an army engaged in besieging a fortress, or to defend a position; but experience has rendered us wiser, and we no longer employ them in a siege, but have recourse to the lines with intervals whenever we require to defend a position of some extent.

At Arras, in 1634, Turenne made three false attacks on the lines constructed by Condé and the Archduke Leopold, and succeeded in forcing them.

In 1656, at Valenciennes, the lines of Turenne were also forced by Condé.

In 1706, at Turin, Prince Eugene defeated Marsin, who awaited him behind his lines.

In 1793, the Prince of Cobourg, commanding the Austrian forces (60,000), was attacked in his lines at Wattignies, by General Jourdan, at the head of 40,000 French troops, and was compelled to raise the blocus of Maubeuge.

It was during the Seven Years War that the Prussians and

Austrians had recourse to powerful combinations of lines with intervals. The most remarkable were those of the King of Prussia, near Jauernig; those of H.R.H. Prince Henry, near Liebenthal, in 1759; those at Colberg, in 1761; and those of the Austrians at Dippoldiswalde, in 1759; at Roxdorff, in 1761; and upon the high Eulengebürge, in 1762. In the Peninsular war the most celebrated were those constructed at Torres Vedras, by the Duke of Wellington, in 1810.

With regard to the employment of fortifications for the defence of a country, it may be observed that fortifications have been employed to defend frontiers more by *routine* than from imperious necessity. Systems, too, have been proposed for that purpose. The most ancient plan, which bears the name of Vauban, although this engineer often complained that too many fortresses were built, is designed to cover a frontier with a triple line of fortified places, with the view of detaining the invader as long as possible with small forces whilst an army is being organized.

At present, however, invading armies are numerous enough to pass between these lines without having much to fear from their small garrisons, and the examples of Holland in 1794, and of France in 1814, lead us to inquire whether this enormous outlay on artificial defences is not altogether useless.

We have seen the Romans at Trasimene and Cannæ, Hannibal at Zama, Scipio at Thapsus, Sextus at Munda, Melas at Marengo, Mack at Ulm, Brunswick at Jena, defeated, and unable to rally their forces even amidst their fortresses, and close to their capitals.*

In this system, routine had the greatest part. After the struggle of the middle ages, Europe was seen dividing itself into a limited number of kingdoms; these swallowed up the states of smaller importance, enlarged themselves by the addition of dukedoms and earldoms, and sought to establish themselves on strong bases. Of all fortifications, those which nature supplies are still the best; but every state could not succeed in obtaining for itself such boundaries; even to the present day the coincidence of political with natural divisions is regarded as an impossibility. It happened that to restrain a too warlike nation—to keep in check a too powerful

* Montholon, *Mémoires de Napoleon*, tome ii. p. 20.

country—the European states imposed on each other frontiers of an irregular shape. The consequence was, that in order to protect the defenceless part of these frontiers and to close the openings, citadels were erected. Political events changed, and with them the frontiers advanced or retreated as the tide of the sea. At every change the same phenomenon took place, and it is in this manner that the surface of European states offered so great a number of fortified towns, scattered without any apparent combination.

In France, Vauban and his successors improved all *these* fortresses, and, as several lines were found to exist, it was taken for granted that they were built according to the regular system alluded to.

It has been said in defence of this system, and it is still repeated, that an invading army would not dare to venture in a hostile country leaving several fortresses in its rear, because its communications would be cut off. But the invading army is exposed in a limited number of points only to the combined and therefore uncertain attacks of the garrisons, each about 6000 men strong. What may be the strength of the invader? Experience shows that there is no exaggeration in valuing it at 300,000 men. If this army leaves on the frontier a corps of 50,000 men to observe the fortresses, their garrisons could not go far off without exposing themselves to be carried off by a much superior mass, and there will be still left 250,000 men to march into the interior of the country. But *they* would not dare do so! Why? The defensive army, already inferior since it is on the defensive, has been diminished, owing to the necessity of placing garrisons in every fortress—in *every one*, since it is not known which of them the invader intends attacking. For a frontier of 150 miles, requiring about 21 fortresses, the defensive army loses 125,000 men condemned to remain inactive! If in 1814 Napoleon had not scattered garrisons in Dantzick, Homburg, Magdeburg, Wurtzburg, Glogau, &c., and had collected these forces on the Rhine, they would undoubtedly have delayed, if not altogether prevented, the invasion. The great accumulation of fortified places on a frontier has, besides, the inconvenience of entailing a very heavy expenditure on the State. Valuing the mean cost of a fortified town at 600,000*l.*, how many millions will be swallowed up by a

frontier 150 in length? Look at France, who numbered 186 fortresses in 1829, and judge of what she pays for their maintenance alone. Bureau de Pusy, in 1791, said that with that amount he could organise an army of one hundred thousand men.

Modern statesmen have laid aside this system, and proposed new ones. Among the most celebrated we find General Rogniat's method of *Retrenched Camps*. He proposes to leave the frontier open, and to entrust the defence of the country to a numerous army, that will find support in a series of retrenched camps resting on fortresses, and distributed from the frontier to the central stronghold, in such a manner that the army could always find one within fifty miles. He intends this army to defend the country while other forces are being organized, checking the advance of the enemy by skilful manœuvres, and driving him to attack the defenders on their prepared ground of the retrenched camps. This system, which has been favourably received, has not yet been put into operation. It is therefore difficult to decide upon it. It starts, however, from a *true principle*—that of entrusting the defence of a country to the *army*, and not to *mere fortresses*. But the invader can also have recourse to skilful manœuvring, and march directly upon the capital, which, according to General Rogniat, is not fortified.

General Duvivier proposed to have only one place in a country—but an immense one, 40 miles in diameter!—where all the resources of the State are to be accumulated, so as to preclude the idea of ever attempting its attack, whilst the defensive army struggles on the frontier. Unfortunately, before arriving at the realization of this *delta*, the manners, government, &c., of our times must greatly alter.

The method which seems to be adopted now is to fortify the capitals, in order to secure them against a coup-de-main, and to have on the frontier fortresses provided with retrenched camps. In this country the sea forms a natural defence, and with the construction of batteries and forts around the dockyards and arsenals, it is by many considered as sufficient. Dreamers however have not failed to prepare plans for constructing a permanent system of defence by means of fortresses both along the coast and in the interior.

Instead of perusing all these plans, let us conclude with a few remarks.

A system ready-made is like a formula of algebra,* applying to all cases, common sense being sufficient to work it correctly; but in the defence of a country is a system advisable? Will the invader act exactly in the way foreseen? Will every fortress, line, &c., be called into play? The world of impossibilities daily diminishes, and more especially in war, where almost everything is to be considered as a probability, and provided against accordingly. Alexander, Hannibal, Napoleon, have astonished mankind by the boldness and novelty of their operations; and this may still occur. Therefore let us beware of these systems, ready-made and answering every purpose, and let *common sense* be our guide. The lines of Torres Vedras were a better defence for Lisbon than any bastioned or tenaille enceinte, yet they were mere field-works.

In this country especially, where an invader is obliged to cross the sea, where military ports are fortified and safe against surprise, there is plenty of time left to prepare *field defences* of the most formidable description. Let us at present remember that armies are more numerous and more rapid in their movements than formerly, and that a fortress has no influence but on the ground seen by its guns, and that is only when it is a place situated *there*, and *there* only, *where* the enemy *must* pass, that permanent fortifications are advisable.

Monday, 4th May, 1857.

COLONEL THE HON. JAMES LINDSAY in the Chair.

ON PERSIA AND THE PERSIANS.

BY LIEUTENANT-COLONEL SIR HENRY RAWLINSON, K.C.B.

(Abstract.)

SIR HENRY RAWLINSON gave a most instructive account of Persia, it being rendered the more interesting in consequence of the military operations in that country, and the daily expectation of news of

* General Duvivier.

the attack on Moham'rah. It had been originally intended to give Sir Henry Rawlinson's Lecture *in extenso*, but unfortunately his time had been so completely occupied by business connected with the state of India, that he was unable to prepare his Notes for printing.

Sir Henry divided his Lecture into four heads : The Geographical Divisions and Physical Features of the Country ; The Inhabitants and their Characteristics ; The Constitution and Organisation of the Army ; and, Remarks upon the present War.

Persia has no resemblance whatever to any country in Europe, and with regard to the countries of Asia, Persia stands *per se*. It has none of the tropical peculiarities of India or of China, or of those countries with which Englishmen are generally acquainted. It is very different from Asiatic Turkey. It consists of an enormous plateau, a high table-land, shut in between two ranges of mountains, one of which runs to the north, and the other to the south-west ; one being a continuation of the Taurus, and the other of the Caucasus. It is further intersected by ranges of mountains diverging from, yet forming parts of, these two great ranges, with small valleys intervening between them. The general character is therefore one of extreme sterility, and the want of water is the prevailing evil. Of course in a country so extensive there must be great diversity and variations of climate from extreme cold to extreme heat. In the north, about Tabriz, and along the mountains, the cold is much greater than in England, while in the south, in the Persian Gulf, and along the coast, the heat is much greater than in India. Another thing which strikes the traveller is the great want of wood. There is hardly any wood in the country, except in the low land along the Caspian, where there is a belt of about twenty miles in diameter, from the north to the south, thickly wooded with dwarf oak ; with that exception, and that of the low land in Ghilan south of the Caspian, there is no wood : the hills are perfectly bare, and in the valleys the only wood is that which is grown in the gardens. There is positively not a hedge in the country, from one end of it to the other. The real evil, however, is the want of water, which the inhabitants endeavour to remedy as well

as they can by subterranean aqueducts; but water is so scarce that they are obliged to exercise the greatest ingenuity and labour, in order to secure a supply. Some of these works may be termed subterranean tunnels, and are as much as 300 feet in depth, and they are continued for a distance of 20 or 30 miles. These works are in fact the only means they have of carrying on cultivation in a mountainous country; without the water thus supplied they could not raise grain of any sort whatever.

There are a vast number of different races inhabiting this extensive country. The conterminous country between Persia and Turkey is inhabited by the Kurds. In that part they speak Turkish; Persian is utterly unknown—it is not exactly Turkish, but a Turkish dialect; on the Caspian, they have a sort of *patois*; but down the middle of Persia the Persian language is spoken. On the east, there is an enormous salt desert, with very few inhabitants. The character of the country is such that a traveller has described it as “the salt desert, and the desert that was not salt.” This is a little exaggerated, although certainly the greater portion is desert; but there are rich spots, especially on the banks of the Caspian, well wooded, and well watered, full of mulberry trees, which supply about three quarters of the whole of the raw silk which is used in Russia, and which is of great value. The eastern province of Persia is called Khorassan, and is of very great extent. Khorassan is conterminous with Affghanistan and Herat, and in fact the word Khorassan, meaning the eastern country, is made use of in India generally to apply to the whole of Eastern Persia, as far as the confines of India, so that the Indian travelling across the Punjaub says he is in Khorassan; they think it is all Eastern Persia from the Salt Desert to the Indus.

Sir Henry proceeded to describe the inhabitants of the country. He stated there have always been in Persia two great ethnic elements, which have not been at all understood, or appreciated. There is what is called the Arian and the Syriac element. In the earliest times Persia was inhabited by tribes all belonging to that race which is called the race of Ham in the Bible, contra-distinguished from the Arians of India and of Europe: the Arians were Hindoo-European nations who extended from India

throughout Europe. At the present day in the mountains of Khorassan there are many remarkable dialects spoken, and which have very little connection with Persian, except in certain general features. The vocabulary is entirely different, and that vocabulary is absolutely the very same as the language of Babylon in the time of Nimrod, and distinguished entirely from the Assyrian, and the Semitic; and, besides that, in the actual inscriptions of Persia there is always one translation given in this old language, which is particularly the vernacular language of Persia. Persia was originally a mere province of Kars.

After Cyrus had obtained possession of the whole empire, the name of Persia was applied generally to the country, by the people who constituted his subjects. They were Indians and Arians; and at present the language spoken by the people is more or less connected with the original language spoken by the Persians of Cyrus. In some cases it has entirely overlaid the old Syriac, but in others the Syriac predominates. At the present day the only recognizable distinction is between the Persians and the Turks. These Turks are comparatively modern colonists, for it is only about 1000 or 1,400 years since they first crossed the Oxus, and came into Persia, and at present half the population is Turkish, and the same race in fact as the Osmanli Turks, speaking almost the same language. The ethnic division at present is Persian and Turkish, but there is a still stronger division in the manners of the people. One half of the nation lives in tents, and the other half lives in houses, and this distinction is much greater than might at first be supposed, because it involves an entire distinction in the way of life. The former are mere shepherds; their life is pastoral, they live by their flocks and herds; the latter are agriculturists. The former, however, do attend to agriculture in a small degree; but, after they have sown their grain, they leave a few watchers while they attend to their flocks. In general those who live in tents have summer and winter pastures, and they migrate from one to the other with their flocks and herds: they derive all their notions of property from their produce. They are a people of particular interest, because they furnish the great mass of men for the Persian armies. They are the fighting class, and, as such, are of great

importance ; because they are far superior in all the best qualities, both mental and bodily, to the Persians of the towns. They are comparatively honest, they are certainly brave, and they possess many of the characteristics of the hill or mountain tribes of Europe ; but, at the same time, it must be confessed that they are extremely lawless, and they are under very little control, except that of their chief, and he is generally a lawless character himself, and encourages freebooting, and all those atrocities, as we call them, but which they think are virtues.

The army is derived chiefly from the tribes that have been described. There are in it four great branches—the Regulars, the Irregulars, the Artillery, and the Cavalry. The Regulars are, of course, the most important ; and they are generally drawn from among the tribes, one from each family ; and they serve sometimes for seven years, generally for life. The military service is not much liked, for very little care is taken of soldiers in Persia. There is no such thing as a commissariat ; the pay is very small under any circumstances, and that very little is never paid—they have been five and six years in arrear. In Turkey they are sometimes two years in arrear, but there the soldiers are very well fed. The rations of the Turkish soldier are better than those of any European Army ; but in Persia there is no system. The men get, nominally, a little bread, but they are very frequently reduced to anything they can get—grass or heps and haws, dry corn, or acorns, in consequence of there being no commissariat ; but, with all that disadvantage, they are a wonderful people. As an animal, a Persian is the finest creature in the world, for an Oriental he is so certainly. They are fine muscular men, and their powers of endurance quite extraordinary. Sir Henry once took the trouble to calculate the distance travelled daily in all the marches of Abbas Mirza. The total distance he traversed was about 2500 miles, and the average distance of each day's march was $21\frac{1}{2}$ miles, and it is perfectly unique in military history to find a march of 2000 or 3000 miles performed by an army of regular troops at the rate of $21\frac{1}{2}$ miles per day. He remembered upon one occasion when he dismissed a regiment, the men of which lived above 150 miles off, that they all returned

to their homes on the third day. They consequently travelled at the rate of 50 miles a-day. The Persian army exists as it is through the English entirely. Some forty or fifty years ago we seem to have felt the necessity of making use of Persia as a defence to India, first against France, and afterwards against Russia. We supplied her with arms, money, and officers, and for thirty years English officers were with that Army, and all the discipline they have they owe to us; and when we read of the square that was formed in the action that lately took place between them and our troops, they were entirely instructed in forming that square by English officers. We are suffering now for our teaching; but, at that time, it was considered that the stronger Persia was the more advantageous it would be for us, and our object was to strengthen her. At the present day, probably the strength of the regular army is about 60,000 or 70,000 men; but that is distributed all over the country, and they could not bring more than from 20,000 to 30,000 regular troops to any one point, and these men, though physically so very good, are so ill commanded, and so ill fed, not paid at all, and ill clothed, that they would not be at all formidable in the field, that is, in front of a British army or any European army, but especially a British army.

The next branch of the army are the Irregulars. These Irregulars are chiefly armed with that weapon of which you have all heard in the Affghan War. It is a heavy matchlock. Sir Henry remembered on one occasion seeing a man, in a skirmish, across a river, on the Kurdish frontier do a remarkable thing. A party of horsemen came from the other side to reconnoitre. This man said he would like to have a shot at them. It was thought the distance was so great as to make it perfectly ridiculous; however, he unslung his heavy firelock from his back (and it weighed some 30 or 35lbs.), fired at the group, and broke it up. Sir Henry found afterwards that he had struck a man in the shoulder, and broke it; the distance was 1550 yards; and it is said a range of that sort is no very unusual thing. On this occasion there was a good mark; the group showed themselves on a rising ground, standing out against the sky, and thus presented a most

favourable object for a shot. The Persian swords are very famous, and are chiefly made in Kurdistan. Their temper is very marvellous ; but they are only of use for a particular method of drawing ; they are of no use as Cavalry swords, or for a sheer cut ; they can be made as sharp as razors. A sword-blade has been sold for 100*l*.

The most efficient arm of the Persian army is no doubt the Artillery ; this was established by Colonel Lindsay, afterwards Sir Henry Bethune, some fifty years ago, and has remained very efficient from that time to the present day. The Persians are extremely clever and inventive ; when they were at the siege of Herat they wanted heavier artillery, so they collected all the copper trays belonging to the different chiefs, and the bells off the mules, got up a foundry, made moulds, and cast at once three large guns, 64-pounders, on the spot, a thing which it would puzzle us to do in a mere desert. It is true the guns did not prove of any great value, for two of them burst immediately, and the third after a short time ; still they actually did cast the guns merely out of the mules' bells and the copper trays in the desert around Herat. The Persian cavalry is also a very efficient arm, and Persia is the only place at the present day where you can see 200 or 300 horsemen charge in chain-armour. The Kurds still wear chain-armour, and actually find it of great use. They ride small horses, very well bitted, and very high bred, and form most admirable irregular cavalry ; but the cavalry generally of the nation has fallen off very materially from what it was fifty years ago. In those days they used to keep breeding studs, and they took a great deal of trouble with their horses ; the chiefs of the tribes generally used to breed horses for their followers, but these chiefs became so powerful that the Government systematically repressed them ; and now in all Persia they could not turn out more than 20,000 or 30,000 horse. When Nadir Shah invaded India he had about 50,000 or more cavalry with him.

Sir Henry next proceeded to say that he thought that we had been accustomed very much to underrate the difficulties of a Persian war, because the Russians have been uniformly successful against

Persia. In the last Persian War, Paskiewich, with 10,000 men, was able to overrun all Persia, that is, all the northern part, routing the Persians in the field, and taking and garrisoning four of their principal cities; and because all this took place we supposed that the Persians were a contemptible enemy, who would yield to the same degree of pressure from us. The north of Persia is very different from the south. When Paskiewich attacked Persia in 1827, he had his own frontier for a base; he had merely to cross the Aras from the Russian magazines, to find himself at once at the seat of battle, in the richest, and most open part of the whole country. There were no deserts to traverse, no mountainous defiles to penetrate; he came at once into a country richly supplied, and comparatively open, with the greater part of the inhabitants in his favour. As long as he remained in this province, he could do as he pleased, but if he had found it necessary in the sequel to advance into the interior, his famous campaign would probably have been a failure; but it so happened that the moral pressure was sufficient, and by merely occupying the country where he was, and threatening the capital, he obtained all that he wanted. Now it is supposed that we can do the same in the south; but that is a very different question. The only expedition that we can compare with this at all fairly, would be the expedition into Affghanistan. We know well the difficulties that had to be encountered there; but those difficulties, such as they were there, would be infinitely surpassed by the difficulties of the Persian War. When we attacked the Affghans, we had an illimitable command of carriage; we drew during that war 70,000 camels from the north-western provinces of India and from Scinde. At that time, certainly, we had not a very favourable base, because neither Scinde nor the Punjaub were in our hands, and our real military base was Ferozepore; but still the inhabitants were to a certain extent favourable to us, and we were able to get supplies through them. Again, we never had any difficulty in the carriage of our supplies in the Affghan war; but the famous passes of that country are really mere bugbears as compared with the Persian passes. Sir Henry had been through the passes into Affghanistan, and most of those in India and Turkey, and he considered the Affghan passes of no military strength;

they are simple defiles penetrating the chains of mountains at right angles, and through which, if you can command the heights on either side, the passage of a column is perfectly unimpeded: but the Persian passes are quite different; there are no ravines running through the mountains there; you have a sheer precipitous range, which you have to pass in the best way you can, sometimes zig-zag, and sometimes along the shoulder of the mountain, the exposed slope of the shoulder, where you cannot protect yourselves, and you must fight your way foot by foot, and yard by yard, in front of the enemy; and this it is almost impossible to do. Again, with regard to the inhabitants, in Affghanistan there were two or three rival classes of inhabitants, some of whom were fighting against the Affghans, and there were rival tribes amongst the Affghans themselves; and where one party was against us, we had the assistance of another. But it would be quite different in Persia. Let us consider now what our position would have been if we had carried on the Persian War. First, we should have to bring everything from Bombay to Bushire, a distance of 1400 or 1500 miles, by water, and, having got there, the first thing—however good the troops may be, however well-fed and disciplined—we should require will be the carriage of supplies, for the country offers none,—we must have either camels or mules; camels, we all know, are invaluable as means of carriage, because they browse, and live upon anything, the ordinary growth of the Desert being their favourite pasture; and they require no looking after. At Bushire you cannot obtain camels; and camels cannot be brought by sea; there are none in the country—or insufficient in number. You must have mules at Bushire; those can be brought by sea, but they require feeding like horses, and the more mules you have the more forage you are required to carry for them. And I think no officer would venture into a country like this without spare forage for his cattle, otherwise he might be completely brought to a stand-still. It might be to a certain extent avoided if we took up our position at Moham'rah—Moham'rah is at the north-west of the Persian Gulf, above the delta formed by the mouths of the Tigris and Euphrates—an attack upon which we may hear of any day. There we could obtain carriage, because camels are obtainable in

endless numbers in Turkish Arabia, and they could be marched down to Moham'rah. By making that our base we could obtain camels, and go a short distance up the country. But even then the difficulties of penetrating are greater than on the other road. It is absolutely impossible either for artillery or regular troops to cross the mountains.

The only tolerably easy way of entering Persia would be from Bagdad, using the Turkish territory as a base; but the Turks, being neutral in the present war, it is impossible so to use their territory, otherwise Persia might be assailed from that side with tolerable success. With regard to the Persian passes, supposing that we had all the carriage that we required, and all the supplies that were necessary, we could not, without an overpowering force of 30,000 or 40,000 men, venture to force those passes in the face of large armies such as the Persians have already collected, say 20,000 or 30,000 men; they having the advantage of the ground, and being able to throw up works, would stop any army of the same, or even of greater numbers.

Then, again, we must remember that the Persians are all of one religion—that is quite different from Afghanistan,—and the Persians would all unite against a foreign enemy. There would be, no doubt, some turbulent, dissatisfied spirits who would join us, with the hope of plunder, but they would be of no military assistance to us. We could not depend, as we did in Afghanistan, on the assistance of any large sections of the people. At Candahar, through the whole nine months, from the beginning of the Cabul insurrection to the end of it, although the Afghan tribes rebelled, other sections of the people were entirely in our favour, who furnished us with supplies. Without that assistance we could not have kept possession of the country; and, unless you have some hold upon the people, you cannot feed your army merely by forays and by foraging parties,—you must have some communications with the people of the country of a friendly nature.

Now from all this it will be seen that the Persian war is one of extreme difficulty. Persia can never become a rich, or a producing, or a manufacturing country, but it will doubtless be turned to great account some day or other as a nursery for soldiers. The

Persian, considered as a mere animal, is so very superior to any other Asiatic—to an Indian or a Turk, or even a Russian—that it is impossible to avoid foreseeing that, as any European war becomes developed in the East, the military resources of Persia must be called into action. In fact, it seems that we could not have a more formidable engine of attack and offence launched against India than a Persian army commanded by Russian officers. In the same way, we could not have a more efficient instrument of defence than the same army led by British officers, or by officers acting in our interests. We cannot ignore the existence of Persia—its geographical position prevents that. It is so connected with India, that we must take it into account in regulating our Indian empire; and consequently, in making an election, it must be recollected that it is better for Persia to side with us rather than with Russia, because she must lose all her political influence before she can become the vanguard of a Russian army,—but as an army of defence her independence is an essential element in the defence of India. As I have shown you the extreme difficulty there is in coercing Persia as an enemy, it is to be hoped that she will see her own interest in allowing us to revert to our old policy, which has guided us for forty years, in determining that her strength is our strength, and looking upon Persia as our best bulwark for India against Russia.

Friday, 15th May, 1857.

COLONEL THE HONOURABLE JAMES LINDSAY in the Chair.

ON THE ARMIES OF ANCIENT GREECE.

BY THE REV. GEORGE ROBERT GLEIG, M.A.,

CHAPLAIN-GENERAL TO THE FORCES.

BEFORE I plunge into the lecture which I have undertaken to deliver, I think it will only be fair both to you and to myself if I state in few words some of the reasons which have induced me to fix your attention to-day upon what some may perhaps consider a very old-world subject. It can be no secret to any one here present that we are on the eve of great changes, and I hope of great improvements, in many points which bear upon the general arrangements of our army. I believe that before long the profession of arms will take its proper place in public estimation—that young men intended for the service will themselves see, and their relatives be taught, that they must exercise their minds as well as their bodies before they enter it; and that officers having received their commissions will be led to perceive that they have undertaken the practice of a great art, which requires as much study as any other art or science with which common men are familiar. Now I am not going to give you my own opinion upon any of these matters; but in one point I think you will all agree with me, that the preparatory education of young men intended for the army can no where be better carried on than at our great public schools. You may depend upon it that the moral discipline exercised in these places is of unspeakable benefit to all who go through it, and that even classical learning, though it be so much the habit to undervalue it, lays no bad foundation for that special training which, when he attains to a certain age, I hope every young man intended for the army will hereafter undergo.

Among other subjects, the mastery of which seems to be required from an accomplished soldier, there is one which cannot but be obvious to all—I mean Military History. It is a great mistake to suppose

that only those portions of military history which we find in works of modern date, deserve the attention of the military student. I tell you, on the contrary, that a boy at one of our public schools, if he be under the guidance of a judicious tutor, will find in the Greek and Latin books which he is required to read, not merely the means of acquiring a knowledge of two languages, beautiful in themselves, and lying at the root of all others which are spoken in Europe, but a vast deal of information which he will find useful to him in his after-career. Therefore it is that I propose on the present occasion to talk to you about the constitution, the tactics, and the movements of the armies of the Greeks, and to illustrate my views by describing to you one great military operation. And hereafter, should circumstances enable me to do so, I may possibly go on with the subject, leading you through the Roman armies to the modern armies; for the purpose of shewing you that the principles of the art of war never vary;—that they are the same in all ages and in all countries, though tactics necessarily undergo changes with the changes of arms which the progress of time and invention has brought about.

So much for my introduction.

I dare say that no scholar here present will be surprised when I say that the oldest writer upon military subjects with whom we are acquainted is Homer.

You will observe that, in so expressing myself, I take no part whatever in the controversy which once upon a time taxed so severely the skill and ingenuity of the learned in this and other countries. For it is of very little consequence to the matter now under discussion whether we accept Homer as a veritable man, the son of Chritheis, the blind bard of Smyrna, or look upon him as a mere myth;—an abstraction like our own Ossian, under the shadow of whose name traditionary poems long handed down from one generation to another were at last brought together and connected. In either case there can be no doubt of the great antiquity of the *Iliad*, to which the best authorities, and among them the Arundelian marbles, assign a date of between eight and nine hundred years before the birth of Christ. It is past dispute that by a countless majority of those who read that glorious epic, either in translation or in the original, little else is

looked for except the imagery with which genius of the highest order can invest any subject with which it has to deal. All beyond, is accepted as a description of the barbarous usages of a barbarous age, when men, going forth to battle, entered into it as Irish factions used to enter into their fights a quarter of a century ago; heaving fragments of rock one at the other, or engaging in savage duels, which never terminated except by the slaughter of one, and sometimes of both the combatants. The few who look deeper into things discover much more than this. They perceive that, so early as eight or nine centuries before the Christian æra, war had become with the Greek nation conspicuously an art. They observe that a number of petty and independent states or clans, all speaking the same language, all descended originally from the same stock and connected by similar institutions, enter into an alliance for the attainment of an object common to the whole; that they elect one chief to command the allied forces, which consist of contingents or divisions, each having its own chief or general at its head; that the several states supply—not men only, but also stores and means of transport, more or less extensive according to their respective resources; and that the expedition assembles, sails, and makes good its landing in the enemy's country with as much regularity as a year or two ago the combined fleets of France and England passed the Black Sea and disembarked their armed cargoes on the beach near Eupatoria. Reading on, they discover that the first thing done by the invaders is to secure to themselves, in case of a reverse, the means of a safe retreat; that they draw up their vessels along the shore so as to place them out of danger from the sea, and protect them against assaults from the land, by covering them with entrenchments. Meanwhile, with a view to guard against the failure of provisions, not only are foraging parties sent out to sweep in the enemy's cattle, but arrangements are made for the establishment of regular markets, which are to be supplied by vessels appointed to pass to and fro between the camp at the mouth of the Scamander and the sea-ports in the neighbourhood. Again, when military operations begin, the troops are not let loose to shout and struggle like a mob, but the army is marshalled exactly in such order, as, looking to the weapons which the men carried and the nature of the ground over which they were

to move, appears to competent judges of the present day to have been the best that could have been adopted. There was no cavalry then with a Greek army. The art of breaking and managing horses to be ridden was either not yet invented or had made very little progress, at all events in Greece. But chiefs and officers of rank rode to battle in chariots, which they used more frequently to facilitate their movements from place to place than for any other purpose. You know how the Homeric chariots were managed. Two men rode in each—one to guide the horses, the other to fight. When the proper moment to engage arrived, the warrior descended from his chariot and fought on foot. When the weight of his armour or any other circumstance led him to desire rest, he moved towards his chariot, which the charioteer had withdrawn just out of reach of danger to himself and to the horses. And the charioteer, driving quickly up, took him in and went away with him. It is worthy of remark too that charioteer and warrior never changed places. Indeed it was the last order given by Agamemnon before dismissing his chiefs to their respective commands, that this division of labour should on no account be interfered with—that, if a warrior had the misfortune to have his chariot captured or his charioteer killed, he should not pretend to take the reins, but get into any other which seemed to have room for him, and continue the battle as before.

The chariots, however, though presenting a formidable array, were used only by men of rank. The masses were organized into two, and only two, kinds of infantry—one light and irregular, carrying horn-bows, short darts, and slings; the other regular, and heavy—armed with spears. Short swords or knives seem also to have been worn by all, and the spearmen, besides incasing their trunks in armour, carried shields on their left arms. The shields and armour of the chiefs were gorgeous, as the description of that of Achilles shows. The cuirasses of the infantry were mere plates of brass, from which depended a sort of quilted petticoat reaching to the knee. The feet were shod with sandals, and the legs were bare. No Greek helmet had at any time a visor. The light infantry wore no armour except on the head, but were equipped in jerkins and kilts of skin or leather.

In the plain before Troy, the Greek army seems to have moved to

the attack in three lines. The light infantry covered the advance, but retired behind the line of chariots as the opposing armies began to close. This seems to have been done for the two-fold purpose of affording to them some protection while discharging their missiles, and of keeping them from dispersing; for the heavy infantry, with levelled spears, formed the third line. But it is not necessary to go further into these details, on which indeed I have touched for the single purpose of drawing your attention to the fact, that, even from the pages of a Greek poet, the soldier may learn something, which, if he have been, during pupilage, in the hands of a skilful tutor, shall not prove altogether useless to him when studying his profession.

In times long posterior to that of which I am now speaking, when the patriarchal had given way to other forms of government, every freeman in a Greek state, not incapacitated from age or infirmity, was liable to military service. From eighteen to forty all indeed were obliged to serve, when the occasion arose, and all served gratuitously. But in Athens the youth between eighteen and twenty was, like the man who had passed forty, kept at home to guard the city. After twenty he took his part in the campaign. After sixty he might hang up his arms in the temple of Athenæ if he chose, and pass the remainder of his days in peace. The Spartans, as a general rule, were more chary of the health of their young men. They trained them indeed to habits of great endurance, but never, except when hard-pressed, sent them to take part in operations in the field till they had attained the thirtieth year of their age. Both states, as indeed was the case throughout Greece, branded their soldiers in order to hinder them from deserting; but of such brands, as they were impressed on the arm or on the hand, no man was ashamed; they were honourable distinctions. Hence St. Paul's well known expression, "I bear in my body the marks [that is, the brands, stigmata] of the Lord Jesus." They were inflicted upon me to disgrace me; but they are my glory, for they mark me as a soldier even unto death of the sovereign to whom my fealty is pledged. Slaves, on the contrary, were branded on the forehead.

Greece is not a country adapted for cavalry, and it was long before any of the state mounted any portion of its troops. Neither is it accurately known by whom the art of equitation was introduced

among them. The Amazons, the Centaurs, Bellerophon, and Neptune all get credit for having first broken-in horses for the saddle; if indeed it be admissible to speak of saddles in ages when such things had no existence. For the equipments of cavalry among the ancients were extremely rude, down even to the times of Lucan. That writer describes the Massylians of his day, as not only destitute of saddles, but as guiding their horses by the switches or whips which they carried in their hands.

The Numidians of Jugurtha's time, the Lybians, and the Scythians so late as the Roman Empire, had no bridles, but managed their horses by the mere inflexion of their voices. Virgil tells us that the inhabitants of Pelethronium, a town in Thessaly, were the inventors of bridles. Pliny attributes the invention to an individual called Pelethronius. These are mere traditionary tales, with the accuracy of which we are not much concerned. But whoever may be desirous of tracing the progress of equitation in classic Greece will do well to study the subject at the British Museum, where the marbles which adorn the walls will show him graceful figures, some bestriding bare-backed steeds, others seated upon skins. He will observe also that there are no stirrups; for young men long ago were in the habit of leaping from the ground to their horses, or they trained their horses to stoop while they were mounted. For the aged, accommodation was provided by placing stones at convenient intervals along the sides of the roads.

We read in classic authors of war-chariots furnished with scythes at the axle-trees. These were the invention of the barbarians. The Greeks tried, but soon laid them aside, for they proved as dangerous to friend as to foe. If the nerve of the driver failed, or his horses became unmanageable, they were just as apt to dash round and sweep through the ranks behind as to press on, carrying destruction into the ranks in front of them. And so in after-times it fared with elephants and camels,—with the former especially, which, though very formidable when first seen, gradually lost their terrors. They also were used for a while in the Greek, or rather in the Macedonian, armies; but a short experience made manifest the fact, that in battle they could not be depended upon. When wounded or frightened, they ran wildly over the field; and the Greeks, seeing

this, made use of them at last only as we use them in the East, as occasional beasts of burthen. But I am anticipating.

Among all the Greek states, the most warlike throughout, and the first to systematise her military resources, was Sparta. We find her, about five centuries before Christ, mistress of the whole of Laconia, with a territory which is covered on three sides by the sea, and a capital protected on the north by an almost impassable frontier. She owed her military, not less than her civil, constitution to Lycurgus, and it was admirably adapted to the political circumstances of the age. As I have already said, every man from eighteen to sixty was liable to military service. The youth of the various districts and villages were enrolled into *enomoties*, or companies, each consisting of twenty-five, or thirty-two, or thirty-six men. These drilled and practised their military exercises together, under the *enotomarch*, who was promoted to command because of his strength, activity, and skill, and who took his post on the left in the front rank when the company formed line, and moved with the leading file on the march. The line was never less than three, nor more than six deep; and it changed front by wheeling and counter-marching, very much as a company or sub-division does among ourselves. It was the nucleus of the whole military system of Sparta—for all the additions made to it were but multiplications of itself. For example, the *pentekostos*, the *lochus*, and the *mora*, were,—the first, two *enomoties*; the second, two or four *pentekosti*; and the third, four or more *lochi*; that is to say, four hundred, six hundred, sometimes nine hundred men. So also, while each *enomoty* had its *enomotarch*, or subaltern, each *pentekostos* had, over and above these subalterns, its *pentikoster*, or captain; each *lochus* its *lochage*, or major; and each *mora*, or battalion, its *polymarch*. From the *polymarch* orders were passed on to the *enotomarch*,—just as among ourselves captains take up the word from officers commanding battalions, and execute battalion movements by rightly handling their companies.

You need not be told that, in civil life, the frame of the young Spartan was systematically hardened by exercise. The drill of the soldier, likewise, consisted almost more in the practice of gymnastics than in anything else. His lance or spear exercise was very simple.

He extended and closed his files according as the necessity of enlarging or contracting the front of the line presented itself; and he was trained to march in cadence to the sound of a flute, which in war as well as in peace modulated his tread. The other states of Greece did not attain to anything like the same regularity till much later; and, as they proved to be little more than mere copyists from the Spartans, I should but repeat what I have said already were I to speak of them in detail.

A Spartan army was always commanded in the field by the king—or, in the event of his non-age or incapacity, by a lieutenant chosen to act for him. In Athens, where troops were raised by tribes, each tribe furnished its own general, and all the generals were possessed of the same degree of authority. Now, as there were ten tribes—and, therefore, ten generals, this was prone to lead to vacillation and difficulty—for only in councils of war could operations be decided upon. It not unfrequently happened that votes were equal, till at last a *polymarch*, or President of the Board of General Officers, was chosen, who, in cases of this sort, gave the casting vote, and assumed absolute authority over the rest. Such was the conduct of Miltiades in that hour of peril, when the hosts of Darius swarmed upon the Greek shore, and the battle of Marathon, with the rapid march back to Athens at its close, saved Europe from the barbarism with which it was threatened.

Till Greece came into hostile collision with Persia, the wars of her various states were upon the smallest possible scale. Argos, for example, quarrelled with Corinth, or Sparta fell out with her next neighbour—and the army of the one invaded the territories of the other, burning villages, laying waste fields, and fighting battles, when the forces from either side met. This was their summer's occupation, at which season, under a genial climate, there was no great hardship in sleeping out; and it does not appear that their longest marches ever carried the troops more than forty or sixty miles from home. In winter the armies broke up, the men returning to their villages and cities. The preparations for a campaign of this sort were of the simplest kind; no commissariat was organised, because none was necessary, but each soldier, carrying with him a few days' provisions, was ready for whatever might befall. A little

salted meat, cheese, olives, onions, and dried fruit constituted the food of the soldier during the campaign. These he bestowed in a casket of wicker-work, in other words in a basket, which he slung at his back. The basket had a peculiar shaped mouth, and was called the *gulion*—whence men with very long necks got the nickname of *gulionchenes*.

Time passed—and, by a process which is visible in all parts of the world where small states adjoin, Sparta and Athens gradually overshadowed their neighbours, and became rivals in the arts both of peace and war. Sparta continued to the last a strictly military nation. Athens became more a naval than a military power; yet she by no means neglected her army. On the contrary, an Athenian officer proves to be the first great military reformer, prior to the appearance of the Macedonians on the stage. About the year B.C. 390, Iphicrates addressed himself to remedy the defects which up to his time had been apparent in the equipment and evolutions of light troops. Heretofore these people, indifferently drilled, and armed only with knives, short darts, and bows, served rather to distract and annoy than seriously to check or restrain the well-disciplined battalions to which they were opposed. For they were collected in a hurry, and let loose upon the enemy with such weapons and appointments as happened to be available for their peaceful occupation as shepherds. Iphicrates took them in hand, lengthened both their javelins and swords, of which he stored up supplies for them in the city, and protected their legs from scratches and bruises by casing them in leathern leggings.

Gentlemen, it is curious to observe how, in small things as well as in great, the customs of society go round in a circle. We had, some years ago—we still, I believe, have in use among us—boots named after two illustrious commanders, Wellington and Blucher. In Athens, for many days after the time of Iphicrates, leathern leggings were known as *Iphicratides*.

It is not necessary that I should speak of the causes which led to the alternate wars and alliances which connected Greece with the Persian empire, and ended at last in the overthrow of the latter. The Greeks, straitened at home for room, and much addicted to commerce as well as piracy, settled colonies, as you are aware, at a

very early date, along the shores of Asia Minor, which, supported by the mother-country, maintained through many ages an uneasy independence upon the larger states and provinces which surrounded them. This became a hard task to achieve, after Persia, under the successors of the great Cyrus, had absorbed the vast empires of Babylon and Egypt; and that of Sardis would not have been accomplished at all, had not Athens and Sparta, but especially the former, entered freely into the struggle. Indeed, it was as much by policy as by war that the colonies held their own at all, for they not unfrequently kept the conqueror at a distance by paying tribute, and supplying him, as allies, with troops, which he found of extreme value to him in his operations elsewhere. It was this intercourse with Persia which led to the raising in Greece of corps of cavalry, which seem at first to have been universally equipped with helmets and cuirasses, and to have carried, as offensive weapons, darts and crooked swords. They were divided, like the infantry, into troops and squadrons, and had generals of the special arm placed over them, who, however, took their general orders, as among ourselves, from the *strategos*, or commander-in-chief. But we will, if you please, pass lightly over what may be called the transition state of the Greek armies. If you desire to satisfy yourselves as to what they had become, and what they were able to effect, and did effect, ere yet, under Philip of Macedon and his son Alexander, they had attained the perfection of their organisation—read the history of the Peloponnesian war, as Thucydides has recorded it, and the *Anabasis*, or *Retreat of the Ten Thousand*, by Xenophon. Read these narratives, too, not for the mere sake of storing your minds with the knowledge of things passed, but that you may learn lessons which, should it fall to the lot of any of you at any time to command armies, may prove of the greatest possible use to you in the hour of need. For I do not hesitate, even in this presence, to give it as my opinion, that nowhere in military history are more instructive lessons to be learned in the art of war, than in the simple and intelligible story of the movements of the force which, after the fall of Clearchus, came under the guidance of Xenophon, and marched and fought its way from the Zab to Trapezus or Trebizond.

The Peloponnesian war, in its results, broke the strength of Greece. It produced, indeed, its heroes and its statesmen—Tolmides, Simon, Archidamus, and, above all, Pericles, the very model of a wise commander, whose speeches, as Thucydides has preserved them, cannot be too much studied, either by the soldier or the politician. But it ruined Athens, and left Sparta dizzy; while, to the north of both, a people was growing into power, of whom as yet little note had been taken. I refer to the Macedonians—a mixture of Greeks and barbarians—whose history is too much mixed up with that of the surrounding tribes to admit of analysis here; and which the most painstaking writers find it no easy matter to give, except with a perplexity of order which sorely tries the patience of their readers. For, the moment we touch them, we find ourselves compelled to notice Thracians, Illyrians, Thessalians, and many more, to speak of whom, without a carefully executed map before us, would involve us in a perfect labyrinth of words. It will be sufficient, therefore, for our general purpose, to state, that Macedonia proper seems to have been early occupied by a colony of Argives; that by virtue of their descent from the leaders of that colony, Philip, and Alexander, his illustrious son, claimed to be regarded as Greeks; and that, for many generations before the birth of the former, we find Macedon mixed up with Greek affairs, sometimes as an ally, sometimes as an enemy, and still more frequently as a bone of contention. Let us take a rapid glance at its condition, when Philip had established his sovereignty over it; and contrast that with the state of Greece, and especially of Athens and of Sparta, as their fatal intestine strifes had produced it.

The Athenian and Spartan citizens of 430 years B.C. were ever ready to brave danger for their country's good. They served her as soldiers without pay, and served her nobly. The Athenian, and, though to a less extent perhaps, the Spartan citizen of 360 B.C., had entirely changed his nature. He loved ease and the pursuits of literature and philosophy, and staid at home, trusting the honour and defence of his country to hired mercenaries. These were gathered in from every state throughout the federation; and, like the Condottieri of the middle ages, were ready to transfer their allegiance from one paymaster to another as often as occasion re-

quired. The Ten Thousand, of whose exploits I have elsewhere spoken, partook in some degree of this character, for they were tempted into the service of Cyrus the Persian by the offer of large pay in the meanwhile, and the promise of preferment after he should have dethroned his brother. Philip, on the other hand, found himself sovereign of a people rude, brave, hardy, prompt for war, but destitute of military organization. Himself endowed with military genius of the highest order, he set about remedying this latter defect; and, notwithstanding the pressure of constant war with his neighbours, he accomplished his purpose. Heretofore, the force of the country had consisted either of mounted men—substantial landed proprietors, who took the field incased in coats of mail, and armed with swords or spears, as the case might be—or of the rural population, shepherds and herdsmen, who carried wicker shields, old swords, slings, bows and arrows, and occasionally, not often, short lances. The towns on the sea-coasts—having been peopled many of them by Greek colonists—could muster their trained bands, whom they equipped, like the *Hoplitæ* of Athens, with spears, but these were few in number; and everywhere else foot-service, being accounted little honourable, was taken up only by the poorest of the people.

Philip entirely revolutionised this state of things. He enrolled the poor and hardy Macedonian landwehr into sections, companies and battalions, brigades and divisions, and, by the armament which he gave them, rendered them superior even to the Greek *Hoplitæ*. These latter, you will recollect, carried pikes sixteen feet in length, which they wielded with the right hand, while on the left arm hung a square and heavy shield. Philip equipped his heavy infantry with pikes, measuring not less than 21 feet in length, which they were trained to wield with both hands, and which, on ground fitted for their use, proved irresistible. The defensive arms of the *phalangite* consisted of a light circular shield, about two feet in diameter; of a breast-piece, leggings of tin, and a broad-brimmed hat, called the *causia*. A man so equipped could of course do little acting singly,—a dense column of such men, on open ground, could scarcely be broken. It is worthy of remark, that each phalangite wore also a short sword.

The telling-off of the Phalanx appears to have differed very little from that of the heavy infantry of Athens and Sparta. The *lochos* in Macedon mustered 16 men; the *syntagma*, 16 *lochi*, or 256 men; the *pentakosiarchy*, of 2 *lochi*, or 512 men. This latter represents a battalion, of which the strength was doubled by Alexander, when he reorganised his army at Suza. But the entire tactics of the force depended upon the unit whence it sprang. On the march, the column increased or contracted its front so as to adapt itself to the width of the road. It could form for battle only on an open space, and then it stood in a line of sixteen deep. The five front ranks levelled their spears; the three next interlaced theirs over the shoulders of the ranks in front of them; the eight in rear stood with shouldered pikes, prepared either to give the weight of their pressure to the advance, or to face about and meet danger, should it threaten from behind. When the hour of trial came, the Greek hoplitæ, with all their courage, found the sixteen-foot lance useless, when opposed to the Macedonian pike—the formidable *sarissa*.

An army composed exclusively of phalangi would, however, have proved unwieldy; so Philip supplied what was wanting, by adding to it two sorts of infantry besides, and two sorts of cavalry. The supplementary infantry consisted, first, of regiments of *hypaspists*, who carried one-handed pikes and shields, like the Greeks; and, next, of light troops—bow-men, slingers, javelin-men—all carefully drilled to skirmish, and inured to the severest exercise. His cavalry were either heavy or light. The heavy wore coats of mail, and brass or tin leggings. Their weapon of attack was the *xyston*, or short thrusting-pike, and the sword. The light cavalry carried lances, about sixteen feet long, and, like the Cossacks of modern Russia, were employed chiefly at the outposts, or to scour the country. The organisation of both was as perfect as that of the infantry, and started from the same unit, viz. the *lochos*. The squadron appears to have numbered sometimes 180, sometimes 250, horses.

A Macedonian army, thus arranged, proved, under Philip's guidance, irresistible. But Philip's wars, like those of the Athenians and Macedonians, were, comparatively speaking, on a small scale;

and hence, though we discover the beginnings of other and not less important arrangements in his military system, we must look to the reign of his successor in order to satisfy ourselves fully as to their nature and extent.

When Alexander came to the throne, he found a school established for the training of officers, which he enlarged and perfected. The sons of the chief men of the country came to the capital as soon as they had reached military age, and were taken into the personal service of the king. They discharged the duties of page, gentleman-usher, and master of the ceremonies. They mounted guard over the palace. They had the ablest masters to instruct them in the arts, and especially in the art of war. They rode with the king when he went hunting, and formed his body-guard in war. He was accustomed to employ them one by one on services the most delicate as well as the most hazardous; and, according as they acquitted themselves to his satisfaction, they were promoted.

Philip had raised Pella from the rank of an obscure town to that of a first-rate city. Here stood the war-office, with its staff of administration, working at least as busily as the gentlemen in Pall Mall, and at the Horse Guards. Here were the great arsenals, wherein arms, carriages, and wagons were fabricated, and everything necessary to render an army efficient in the field stored up and ready to be issued. The barracks were commodious and extensive, with drill-grounds, and spaces for training convenient to them. Into these, recruits were introduced as they came up from the country—cavalry on one side of the arsenal, infantry on the other. They were instructed in their duty as members of *depôt* battalions, and thence sent off by draughts to fill up vacancies in the ranks that were in the field. Moreover, Philip had begun, and Alexander perfected, a complete ordnance corps. He had not only his battering rams, but ballistæ and other engines for throwing stones and darts; some heavy, and therefore suitable for siege purposes; others light, which accompanied cavalry and infantry into the field. Besides all these, he had his land-transport corps, with its train of carts, pack-horses, and beasts of burden, over which military officers presided. In a word, Macedon had been rendered by Philip some-

thing very like a large camp. Alexander took it over in this condition, and rendered perfect whatever his father had left even slightly incomplete. But it was not upon the resources of his own country alone that this extraordinary man relied. Greece stood towards him very much in the relation in which the Confederation of the Rhine stood, in 1811, towards the first Napoleon. Though nominally independent, the states supplied him with troops when required, and adopted his policy both in peace and war, however distasteful to their feelings might be the tone in which they were expressed.

Let us content ourselves with a brief glance at the early career of Alexander. He found himself, on acceding to the throne, the heir of a policy which suited well with his adventurous character. His father had begun to make preparations for the invasion of Persia, and he determined to go on with it. But difficulties met him. Greece, instigated by Persia, and herself impatient under the yoke, endeavoured to free herself from her Macedonian connection. Thrace, Illyria, Thebes, openly rebelled. He overcame all the opposition; he crossed Mount Hæmus, defeated the Triballi, passed the Danube, overthrew the Getæ, carried Thebes by assault, and completely overawed Athens. It is in one of these campaigns,—in his operations against the Illyrians, that we find him for the first time making use of his siege train; driving the defenders of a town from the parapets, with stones and darts, and assailing the walls with his battering rams. But more important operations had been determined upon, and for these the mistaken contempt of his youth, entertained by Darius king of Persia, enabled him at his leisure to make ready.

It was in the winter of 335-334 B.C., that Alexander made his final preparations. His grand dépôt he of course established at Pella, the situation of which was admirable, on two rivers, both navigable for light craft, and within fifteen miles of the Ægean. He appointed 12,000 regular infantry, with 1,500 cavalry, under one of his best officers, to overawe Greece during his absence, and to guard the coast from descents on the part of the enemy. He selected to follow him on his great expedition only 30,000 infantry and 4,500 cavalry;—

wisely considering that mere numbers do not constitute the strength of armies, which ought always to be proportioned to their probable means of subsistence. But his troops were complete in everything that tends to render an army efficient, and a fleet of 160 triremes, with many vessels of smaller size, prepared to move parallel with them as long as circumstances would allow; for he had wisely determined to move by the coast road. How Darius came to overlook or neglect these preparations, warned as he had been by his Greek general Memnon, it is difficult for us to conceive. He was immeasurably superior to Alexander by sea, having the whole Phœnician fleet at his disposal. He might have blocked up the Hellespont and swept the Ægean had he been so disposed, and the entire coast-line both of Macedon and Greece lay open to perpetual attacks and alarms, against which Alexander's army of reserve could have offered but ineffectual opposition. But there was jealousy between his Greek and Persian officers, which produced its customary results. The foreigners were suspected of seeking ends of their own, and the more cautious policy of the natives was adopted.

Alexander distributed his 30,000 infantry into six divisions, or *taxeis*, adopting in this respect an organisation almost identical with our own. His cavalry he distributed into four brigades, of which the light or lancer-brigade numbered 900 horses. The rest made up two heavy brigades and a corps of Greek auxiliaries. I cannot quite make out whether at this stage of his career he had established a bridge equipment. I am strongly inclined to believe that he must have done so, because he had several rivers to cross ere the campaign could be opened, which would probably require bridging. However this may be, it is certain that at a later date a bridge-train attended upon all his movements. Read Arrian's account of his advance upon India, and if any doubts upon this matter should have rested upon your minds, they will at once be dispelled. Alexander moved upon the Hydaspes, carrying with him light vessels mounted upon carriages, which, for the sake of convenience upon the march, were divided, some into two, others into three pieces. Now what were these vessels but pontoons? When he approached the banks of the river, he halted the carriages under the screen of a thick wood, put

the vessels together and launched them raft-wise—pretty much as our own engineers launch their pontoon-bridges on the waters of the Medway, or wherever else they may be called upon to make rivers passable for troops. In like manner Alexander's engines for throwing stones and darts took their places on the flanks of columns, or in the intervals between one brigade and another, where the nature of the country would not admit of parallel movements. His battering rams, wagons, and baggage-horses marched in the rear of his columns on the advance—in their front, if he was practising a retreat. And besides that, the drivers were all armed; a regular guard protected them. Will any body say that lessons in the art of war are not to be learnt from the history of men and of times which seem to have left no point that is necessary to the organisation and management of armies unattended to, which provided not only for the maintenance and support of forces in the field, but cared for all necessary means of supply—in their recruiting—in their treatment of recruits—in their wise establishment of depôts and magazines—in the staff of officials which they kept to manage the accounts of the army, and held personally responsible for the due performance of the duties which the government had assigned to each—which had their military records carefully preserved, and books illustrative of tactics and strategy elaborately compiled? But we will return to Alexander.

Having completed his operations both for offensive and defensive war, Alexander began his march from Pella. He moved leisurely, in order that there might be time for the fleet to meet him at the mouth of the Hellespont. He made a brief halt at Amphipolis, establishing his head quarters in the town. He arrived next at Abdera, and there passed the river Nestus. He then entered Thrace, crossed the Hebrus and Melas, and traversing the Chersonese arrived at Sestos. The Strymon, the Nestus, the Hebrus, and the Melas are none of them very large rivers; but, as Alexander moved with carriages of various kinds, and as the banks of some of them are steep, we may fairly assume, that if he did not find them bridged he bridged them.

The Macedonian fleet had already arrived at Sestos, and the troops were commanded to embark forthwith. While this was doing,

Alexander paid his well-known visit to the site of Old Ilium. He accomplished this feat, so to speak, alone ; crossing the strait in the admiral's trireme, which he steered with his own hand. He was ambitious to be the first of the Macedonian host to tread the Asiatic shore, and he succeeded. But, though full of romance, he was, at the same time, one of the most far-sighted and sagacious generals that ever lived. Having offered his sacrifices, as a hero, to the manes of the dead, he hurried back to Abydos, where his army had begun to assemble, that he might resume the occupations of a great commander. Here a grand review took place, at the close of which the army was distributed into two wings or columns. Of the right column, Alexander himself took command ; the left he placed under the immediate orders of his friend Parmenio. The muster-roll showed that the army was thus composed : Of the Macedonians, partly Phalangis, partly Hypaspists, there were present under arms 12,000. Of Greek allies, armed and equipped like the Hypaspists, 7,000. Of mercenaries, 5,000. All these were fit for close combat. The light troops, chiefly Triballi and Illyrians, armed with slings, darts, and short spears, mustered 5,000, and there were 1,000 archers. Of cavalry, two brigades were heavy Macedonian horse, each 1,500 strong. Two others, one of Grecian horse, 600, the other of Thracians and Pæonians, 900. The most perfect gradations in the order of command prevailed everywhere.

Meanwhile the Persians had not been wholly regardless of the storm which threatened. They declined indeed to be guided by the counsels of Memnon the Greek, and so threw away their superiority by sea ; but, under Arsytes, a Phrygian satrap, they collected a considerable army at a place called Zeleia and waited the issue of events. They were greatly superior to Alexander in cavalry, which the lowest estimate puts down at 20,000. And Memnon, who served under Arsytes, strongly urged that advantage should be taken of this circumstance. He recommended his chief to avoid a general action, to retire before Alexander, laying waste the country as he went ; to beat up the Macedonian out-posts, harass their convoys, and strike at their baggage ; and to attempt more serious diversions from the sea by landing in Macedon, and compelling Alexander to

return for the defence of his own country. But Arsytes was the civil governor, or pasha, of the district. His personal assets depended on the amount of produce which it reared, and he refused to sacrifice his own resources for the sake of the empire. He accordingly advanced to the Granicus, along the right bank of which he took post. Here he determined to give battle, having, as Arrian states, under his command 20,000 excellent horse, and 20,000 or 25,000 good infantry, all of them mercenaries, chiefly Greeks.

The Granicus, though famous in story—first because it is commemorated in the Iliad, and next as the scene of the battle which I am going to describe—is an inconsiderable stream. It takes its rise in Mount Ida, and flows northward into the Propontis, or Sea of Marmora. It is fordable in many places; but the right bank is steep, and therefore offered considerable advantages to the force by which it was that day occupied. It was to cover these fords that the Persians drew up with their left resting upon the declivities of Mount Ida and their right *en l'air*.

Alexander having reviewed his troops at Abydos, rested there that night, and at an early hour next morning began his march. His scouts had made him aware of the proximity of the enemy; he therefore moved with caution, and slowly. He halted the first day at a place called Perkote; the next beside the little river Praktius, and the third at Hermotus. Clouds of light cavalry covered his movements, which he supported with heavy horse in the proportion of one squadron of cuirassiers to four of lancers. His last march from Hermotus to the Granicus he performed in perfect readiness to engage on the first alarm. He appears to have come in sight of the Granicus about two in the afternoon. Parmenio, desirous that the troops should enter fresh into battle, advised a halt till next morning. But Alexander, satisfied that a general action was all in his favour, and against the Persians, refused to listen to the advice. He was apprehensive that the enemy might withdraw from their position in the night, and resolved to deliver battle immediately.

Now observe the skill with which his dispositions are made. While he is arranging his columns of attack, archers, supported by

light horse, push on to the river, skirmish with the enemy, and try the fords. An attempt is also made to clear the opposite bank by shooting stones and darts from ballistæ, and so far succeeds that the Persian cavalry fall back behind the shelter of the high ground of which they are masters. Meanwhile, the Macedonian army forms: the Phalangi take post by double battalions, each 1000 strong, in the centre, keeping an interval between each double battalion. The Hypaspists, or lighter infantry, form to the right and left of the Phalangi, somewhat in advance. These are flanked by the light cavalry or lancers, supported by squadrons of heavy horse; and on the right of the whole line, opposite the principal ford, is the mass of the heavy cavalry. The light infantry, consisting of slingers, bowmen, and javelin men, extend up towards the base of Mount Ida and threaten the enemy's left.

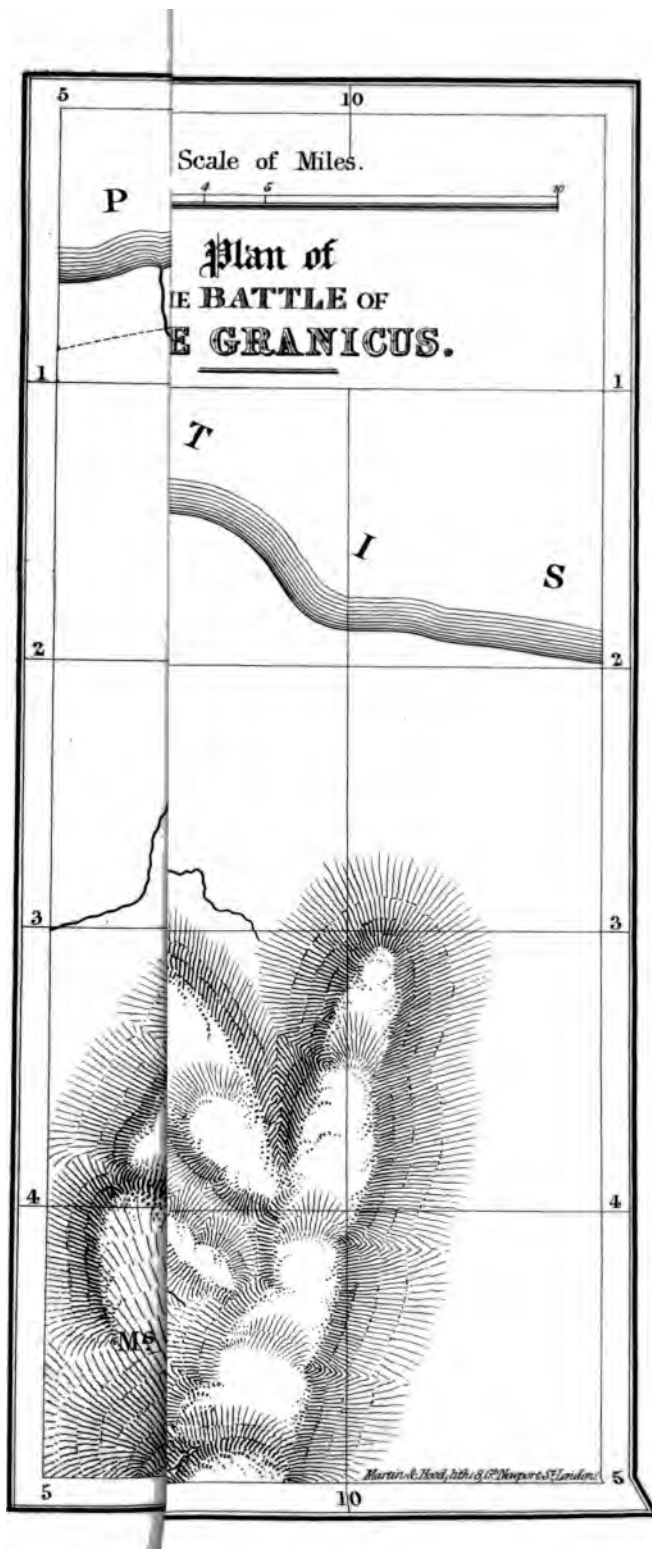
It is not necessary to describe the battle or to speak of its results. The country was open, and there was no smoke, as among us, to confound the vision. All these formations were therefore clearly seen by the Persians; and the Persian horse, as soon as the Macedonians began to move, closed up to their own front again and stood ready to receive the shock. It was given by Alexander's heavy horse, a squadron of his body-guard leading, which the light cavalry or lancers supported, and beside whom, and therefore sheltered in some degree from the force of the current, a division of Hypaspists pushed forward. The resistance was very determined—so great indeed that for a while no man could succeed in forcing his way up the bank—for Memnon was there with the flower of the Persian cavalry, of which a portion rode down to meet the Macedonians in the water, while the rest plied them with javelins from the heights above. But all this while the Macedonian slingers and bowmen were pushing round among the rocks of Mount Ida; and by and by volleys of stones and arrows fell upon the Persians who covered the nearest ford. Then Alexander himself plunged in at the head of a second squadron of the body guard. Then by sheer strength of man and horse the Persians were pushed aside, and steady, yet rapid, the phalanx descended into the river, crossed, and made the opposite bank its own.

The Persian horse was repulsed; but it was still numerous; and

there were 20,000 excellent infantry in line, which had suffered no loss. Against these, Alexander at once led his whole strength. While the phalanx took them in front, the cuirassiers fell upon their flanks, and entirely routed them; for the lancers and Greek allies sufficed to keep the Persian cavalry from rallying. And here was manifested the immeasurable superiority in an open plain of the Macedonian two-handed pike over the one-handed lance of the Greeks. The Greek line could make no impression whatever upon the dense forest of pikes which breasted it; and the slaughter which ensued, when the Hoplyti broke and endeavoured to flee, was terrible.

Alexander's loss was computed at about 1,200 killed and wounded. It is said that of the Persian infantry scarce 2,000 escaped. The speed of their horses carried the mass of their cavalry out of danger.

Such is the page of military history which I proposed to unroll for your consideration to-day. I think that it is wanting neither in interest nor in substantial value. It shows that war has been treated as an art, not by moderns only; that there are other fountains whereat the military student may drink, with refreshment to himself, besides the despatches of the Duke of Wellington and the Commentaries of Jomini and of the Arch-duke Charles. And hence that he who recommends the foundations of a profession to be laid on a broader base than any cramming-school can furnish proposes to the youths who may be ambitious of achieving military renown no useless labour.





May 22nd and June 5th.

COLONEL THE HONOURABLE JAMES LINDSAY in the Chair.

ON CHINA AND THE CHINESE.

BY J. CRAWFURD, Esq., F.R.S.

(*Abstract.*)

IN these two very valuable lectures, the parts most important to the members of the Institution are those upon which Mr. Crawford is most competent to speak: namely, first—the character of the emigrant portion of the Chinese population; and secondly—the war and the negociations which are now being carried on.

Mr. Crawford, from having had charge of the civil administration of Singapore, from 1823 to 1825, and from the connection which he has since maintained with that colony, has, by personal contact with these people, had more than ordinary opportunities of judging of them; while his previous position as Resident at the Court of the Sultan of Java, and the works which he has published upon the history and geography of the Eastern and Indian Archipelago, entitle his opinions to weight, with reference to any operations that may be conducted in that quarter of the globe.

Mr. Crawford, after describing the boundaries of China, and its dependencies, the latter of which, although three times the extent of China Proper, do not contain as many inhabitants as the smallest of its eighteen provinces—pointed out that the grand features of the physical geography of China are its two great rivers, and the vast and fertile plains through which they flow. These rivers, which flow from west to east, are, respectively, thirteen and a half and fifteen and a half times larger than the Thames; and, in fact, it is these, with their branches and tributaries, that have created the great civilization and population of China.

The climate varies, from that of Central Italy to that of Jamaica: in the north, producing wheat and all the products of temperate

Europe; in the south, rice, the sugar-cane, and the productions of the tropics. China, also, possesses great mineral wealth—coal, iron, copper, tin, zinc, lead, mercury, gold, and silver. Of the latter, the quantity must be great, since, until lately, it has supplied the chief consumption of the country itself, and has been often exported. China, in fact, has within itself such a variety of mineral, vegetable, and animal wealth, that, if any country can be said to be independent of others, it is so. This is the view which the Chinese themselves are fond of taking of their country; and, isolated and remote as they are from the more civilised world, their very position in a great measure accounts for their extravagant and irrational national conceit and undervaluing of strangers.

The population is estimated at 360 millions—a number which, spread over the vast surface of China, gives no more than 277 inhabitants to the square mile, probably about 23 less than the present relative population of the United Kingdom. Some of the provinces—those to the north and west—are even scantily inhabited, while the central and eastern provinces, enjoying the benefits of the navigation and irrigation of the great rivers, their tributaries and branches, are very densely peopled. In these portions of China, the land cannot sufficiently feed its own inhabitants, and many of the poorer classes are consequently always in a state verging on starvation. This has given rise to an emigration which has now been going on to a greater or less degree for the last 300 years, but which has never been so rife as at the present moment. By the laws of China, emigration is prohibited; but this law, like a hundred others, is set at defiance, by necessity or corruption. All those who emigrate, are of the working classes, men in the prime of life—for no capitalist ever quits China for a foreign country; and, although each in quitting his native country does so to seek his fortune, and when he has made it to return, yet few attain this end. This accounts for their leaving their families behind them, the motive, no doubt, being the known attachment of the Chinese to the tombs of their forefathers. In this respect the Chinese emigration differs from the emigrations of all European nations. The Chinese emigrants, however, intermarry with the people among whom they settle or sojourn, and the result is a mixed or half-caste population

far more numerous than the China-born. To the credit of the Chinese, it should be observed, that they treat their wives well, and that, consequently, the women of these countries prefer them to their own countrymen. "They work for us," they say, "while our own countrymen are idle and make us do all the work." This mixed race, to whom belong most of the wealthy merchants of the European possessions, although somewhat less industrious, perhaps, than the Chinese, are better informed, and more docile. In the more recently-formed European possessions, the disproportion of the sexes is a great evil—in Singapore, for instance, there are at least ten men for every woman. In all the countries in which the Chinese are settled, it is conjectured that their number may be a million and a half, and in their employments they embrace the whole field of useful labour. They are found as merchants, shop-keepers, artisans, agriculturists, day-labourers, bankers, contractors, &c. In the Dutch and English possessions they are the sole farmers of the public revenue, no other class of the inhabitants, not even the Europeans, being able to compete with them.

Some fears have lately been entertained of the Chinese settlers in our possessions, lest, following the example of the people of Canton, or of the insurgents of Nankin, they might rise against us. These fears, however, Mr. Crawford believes to be wholly imaginary. We have had Chinese subjects for nearly a century and a half, and they have neither plotted nor risen against us. The greater number are peaceable, respectable, and industrious; men much devoted to the pursuits of industry, and very little to the pursuit of politics. The majority, too, being born in the country—that is, consisting not of pure Chinese, but of the mixed race—have little connection with China, except in so far as they respect it as the land of their forefathers. Our conduct has been fair and just towards them; they pay the same taxes as ourselves, and no others; they are governed by the same laws as ourselves, that is, by the laws of England, except in the matter of inheritance, in which they are governed by their own. They sit on grand and petty juries, and some of their chiefs are even in the commission of the peace.

In the parent country, however, the Chinese, as a race, are a homogeneous people; the same from one end of the country to the

other. They differ in physical form from all their neighbours, even from the Tartars, whom they most resemble. Even the mountaineers of some of the western provinces, who have not adopted the religions or manners of China, nor submitted to her authority, are, in race, the same people; and, although in the eighteen or rather fifteen provinces into which the empire is divided there are considerable differences both in manners and language, yet these are not such as to affect that homogeneity which belongs to the whole people. Moreover, although each province has its own language, or at least its own dialect, there is a metropolitan—called by the Europeans the Mandarin, language, which, more cultivated than the rest, is in frequent use as a general medium of communication. It plays the same part that French does in Europe, Hindi in Hindostan, and Malay throughout the Indian Archipelago. The Chinese may be called a stereotyped people; they appear to have made a certain and large advance in civilization and then to have stood quite still. The arts even, in China, are generally quite stationary; their paper continues to be made from the fibres of the bamboo, and is a brittle, perishable article, inferior to any European paper, and commendable only for its cheapness. The Chinese invented printing 900 years ago, but have never gone further than stereotyping from wooden blocks, and know nothing of metallic or moveable types. They invented the compass, but never applied it to navigation. They discovered gunpowder, but confined it to the manufacture of fireworks. Its use for propelling missiles through a tube they acquired indirectly from Europe. They have now been acquainted with it in war for probably 500 years, but are less expert in the use of fire-arms than any other considerable nation of Asia, preferring their ancient bows, from which they shoot harmless arrows in the face of round and grape shot from 32-pounders. They invented silk some 3000 years ago, and their raw silk is far excelled by that of France and Italy, while in the manufactured article they are beaten by France and England. They were the inventors of porcelain, and are excelled by France, Germany, and England; their ware being now brought to Europe merely as a curiosity. They have preserved their superiority in nothing but tea. Their ships, or junks, are of the same form and equipment as those in which

Marco Polo sailed from the coast of China to the Persian Gulf in 1295, a voyage which it took eighteen months to perform.

Mr. Crawford then entered largely into the statistics of trade; questions which, from being imperfectly understood by the people of both countries, have produced sources of irritation between advancing civilization on the one hand and a people thus constituted on the other, and which, of late years, have led to open ruptures. For the balance of our trade, that is, for the difference between the value of our exports and our imports, we pay the Chinese in silver, which is their current money, as it is of the whole eastern world. This balance amounts at the present moment, for India and China—the larger part being for the latter—to a sum not falling much short of twelve millions annually: and there are some among us who look upon this vast export of the precious metals with alarm, as though it were a drain upon our wealth; but it is no more a drain than is our export of iron, or cotton, or woollens. We export silver, because, in a mercantile sense, we do not want it at home—just as we send abroad our surplus produce in ordinary manufactures. The silver would not only be of no use to us, if we could keep it, which is impossible, but the sole effect of retaining it would be to increase enormously the nominal price of every other commodity, and thus to cut us off from all intercourse with other nations. When India and China are saturated with silver, they will take no more; and when they have more than they want, they will begin to export. China did so down to 1851—every year exporting to the value of £2,000,000; but then, no wiser than some among ourselves, she believed that this export of the precious metals was a drain upon her wealth, and, therefore, fulminated proclamations and edicts against opium and the opium-trade, which she believed to be the cause of it, and thus arose the first or opium war. But in all her proclamations and edicts against the opium trade, says Mr. Crawford, she never once spoke of its immorality, or of the injury which opium did to health. They called it “black dirt;” and said that by means of this foreign “black dirt” we were robbing them of their gold and silver. The precious metals were “leaking out,” that was their expression, and nothing coming in but “black dirt;” and if this went on, they added, the Chinese would soon be reduced to the same state of poverty, as that

to which Europeans had, by means of the same "black dirt," reduced the black barbarians of Java and other countries. They thought, and still think, that gold and silver alone constitute wealth, as we ourselves did, and some of us do to this day. They thought, in short, as we did—that there was a signal advantage in possessing more pots and pans than there was food to cook—an illustration of Adam Smith. Previous to these precious edicts against opium, gold and silver had been yearly imported into China; but, the importation of opium having greatly increased after the overthrow of the tea monopoly, the balance was turned against China, and gold and silver came to be exported. For the last seven years, the balance has again been in favour of China, and gold and silver have been largely imported; and since then the Chinese do not consider themselves as being robbed, and not a word is said about the "black dirt." On the contrary, the importation of the drug is as free as that of cotton or iron; and the Chinese themselves are cultivating the poppy and producing a large quantity of opium, although the article turns out to be inferior in quality to that of India.

The present war, or more properly speaking our present quarrel, with China has more of a local than of an imperial character. It has been in progress from October to April, and, although the trade and revenue of Canton have been destroyed, and the second town in the empire blockaded, the Imperial Government, as far as we know, has not taken the least notice of it. We are at open war with Canton; but the other four ports have not entered into the quarrel, and our trade with them goes on only the more briskly that there is no trade at all with the sister port. Even when we attack, capture, and occupy Canton, which we must do, its capture and occupation will have no sensible effect upon the Imperial Government. The other ports will take no heed, and we shall want neither tea nor raw silk.

What then will be the effect of the military operations which are now being directed against this people? They are essentially unwarlike, and have no taste for war, or any employment that has even the semblance of it. They look upon war as an idle and profitless employment. "I once tried them," says Mr. Crawford, "as a constabulary force, and the failure was complete. They were always

looking after their own affairs, and never after those of the public." Should we conquer such a people? or add to our territorial dominion? No greater evil can happen to us than falling into such a mistake. The Chinese are not, like the people of India, divided into several nations and into innumerable castes. On the contrary, they are a homogeneous people in race, laws, manners, and religion, with a strong feeling of nationality, which the Hindus and Mahomedans of our Indian possessions are wholly destitute of. Unless largely intermixed with other nationalities, as they now are in all the European possessions in which they are settled, it would be impossible to rule them. The two tribes of Tartars that within the last six centuries have ruled them, men of approximate race to the Chinese, have only been enabled to do so by themselves becoming virtually Chinese, and sharing the government with them. Should we perform the Kutao? Or, by sending our ambassador to Peking, subject him, as of old, to the insolence and intolerance of the Chinese Government? "I am clearly of opinion," says Mr. Crawford, "that our Plenipotentiary ought not to go a furlong beyond the guns of the fleet." It is under those alone that he can negotiate effectually. The vulnerable part of China by an European power is the great river, navigable for a ship of the line for 200 miles. The possession of Nankin and the debouchment of the Grand Canal into the river, which is near it, enables an enemy at once to place the Chinese capital in a state of blockade, by cutting off the southern from the northern provinces, the latter being fed by the former. From 8,000 to 10,000 Imperial junks are, it is said, constantly employed on the Grand Canal in carrying the taxes paid in kind, namely corn, salt, and similar commodities. By the presence of a fleet and land force in the Yang-che-kiang, in the neighbourhood of Nankin, the main channel of intercourse between the fertile southern and the poorer northern provinces is effectually interrupted, and this, as it did on a former occasion, will bring the Chinese Government to terms. It may be said that the insurgents are in occupation of Nankin—this is true, but they are not in possession of the debouchment of the Grand Canal. In taking possession of either it is possible that we may come into collision with a party that is very insolent, very ignorant, and very sanguinary; but these insurgents, pretending

to be Christians, are not deserving of much consideration. Their progress through the whole breadth of China has been marked by rapine and murder, and they consist, without exception, of the lowest and most ignorant classes of the people. Twice they have advanced towards Peking, and even crossed the Yellow River, and twice they have been defeated and fallen back upon Nankin. Their final success in establishing a native government, and subverting that of the Tartars, does not seem probable; nor is it desirable, for they have no leaders of rank or wealth, and, even if they ultimately succeeded, they would establish a worse government than that they would subvert. They pretend to be Christians, but their Christianity is a profanation of the name, which will not bear examination; and assuredly there is less of the spirit of Christianity in their strange and barbarous religion than in the bloodless worship of Buddha, or the philosophy of Confucius.

To humiliate the Government before such a people in any way that would eventually lead to its overthrow, would be a catastrophe highly prejudicial to our interests. Our object is trade, and what we demand is a free commercial intercourse on terms of equality. No doubt a more decent language has been used by the Chinese since the treaty of Nankin; but the spirit of the Chinese Government in relation to strangers remains unaltered, and we cannot reasonably hope at once to effect a revolution in an inveterate habit which is the fruit of an isolation of 3,000 years. Only, therefore, under the guns of our fleet can our present treaty with the Chinese, in many respects imperfect and ill-defined, be properly rectified, or a new one if necessary negotiated. A demonstration of our power is the most convincing argument. Other nations both wait and watch the result; but in the presence of the assembled hosts it will again be seen that England, although powerful to strike, seeks not alone her own aggrandisement.

Evening Meetings.

Monday, May 18th, 1857.

Colonel the Hon. JAMES LINDSAY in the Chair.

NEW MEMBERS.

The Chairman announced that since the 1st of January 65 new Members had joined the Institution, viz. :—

LIFE MEMBERS.

Capt. W. Paterson, Professor Royal Military College.

Capt. De La Chaumette, late British Italian Legion.

Capt. W. W. W. Humbley, late 9th Lancers.

ANNUAL SUBSCRIBERS.

Lt.-Col. Cure, Gren. Gds.

John Leslie, Esq. 71st Regt.

T. Ligertwood, Staff Surgeon.

Capt. Campbell, Sco. Fus. Gds.

Capt. Viscount Kirkwall, Sco. F. Gds.

Lieut. Stephenson, Sco. F. Gds.

Colonel Seymour, Sco. F. Gds.

Capt. Hon. R. Mostyn, Scotch F. Gds.

Lieut. Stracey, Sco. F. Gds.

Lt.-Col. Lord A. Lennox, R. Sus. Mil.

Lt.-Col. Lord C. Hamilton, Donegal Mil.

Lord Hardinge, Kent Artillery.

Capt. Caulfield, Colds. Gds.

Lieut. Barnaud, Colds. Gds.

Col. Wilford, R. Art. Gov. R.M. Academy

Lt.-Col. Reeve, Colds. Gds.

Capt. Mure, Sco. F. Gds.

Lieut. Elwes, Sco. F. Gds.

Lieut. Paynter, Sco. F. Gds.

Lieut. Hon. E. Brownlow, Sco. F. Gds.

Capt. Hon. C. Hay, Sco. F. Gds.

Lieut. Knox, Sco. F. Gds.

Lieut. Jelf Sharpe, Sco. F. Gds.

J. W. Spurrell, Esq. Admiralty.

Capt. Goodwin, Cambridge Militia.

Capt. Digby, Gren. Gds.

Lieut. Fortescue, Colds. Gds.

Earl of Sefton, Gren. Gds.

Lieut. Hon. H. Edgecumbe, Gren. Gds.

Lt.-Col. Read, H.P. Royal Staff Corps.

J. W. Simpson, Esq. late Apothecary to the Forces.

Capt. Ewart, Gren. Gds.

Capt. Scott, Sco. F. Gds.

Col. Shafto Adair, Suffolk Art.

Capt. Harrison, H.P. 79th Highlanders.

Sir Sibbald Scott, Bart. late Sussex Art.

Lieut. Hon. W. Trefusius, Sco. F. Gds.

Lieut. Beaumont, Sco. F. Gds.

Capt. Jervoise, Colds. Gds.

Capt. Burgess, H.P. Bombay Army.

Major Hackett, late 77th Regt.

Capt. Schaw, Roy. Engineers.

Colonel P. Herbert.

Robert O'Byrne, Esq. Navy Agent.

Lt.-Col. L. Graham.

Lieut. Melville, Gren. Gds.

Commander Cole, R.N.

Major-Gen. J. T. Lane, Bengal Army.

Capt. Stapleton, Gren. Gds.

Lt.-Col. Lord Burghley, Nrthmptn. Mil.

Lieut. Murray, R.N.

Lieut. Bulkeley, R. H. Gds.	Lt.-Gen. Cannon.
Capt. Lambton, Sec. F. Gds.	Lt.-Col. Wilford, Chief Instructor of
Lieut. Palliser, Rifle Brigade.	School of Musketry.
Capt. Hon. H. Campbell, Colds. Gds.	John Davidson, Surg. Ben. Army.
Lieut. R. Home, Roy. Engineers.	Lt.-Col. G. Knox, late Colds. Gds.
H. Harkan, Esq. Assist. Surg. R.N.	Major Hon. S. Vereker, Limerick Art.

INCREASED SUBSCRIPTIONS.

The under-mentioned Officers had raised their Annual Subscriptions from Ten Shillings to One Sovereign since the 1st of January :—

Capt. Dixon, Q. O. L. Inf. Mil.	Major-Gen. Monins.
Admiral Sir John Hindmarsh.	Lieut. Airey, R.N.
Major-Gen. Sir R. Doherty.	Sir Sibbald Scott, Bart.
Lt.-Gen. Sir G. Bowles.	Colonel Thompson, Ret. R.E.
Admiral Lord Aylmer.	W. Hunter, Esq. M.D.
Colonel W. Raban.	Major-Gen. Cameron.
Capt. Carr, Roy. Marines.	Lieut. Okes.
Capt. Goodwin, Bed. Mil.	J. Davidson, Esq. Ret. Surgeon.
Lord Hardinge.	Capt. Hon. G. Wrottesley, R.E.
Capt. John Grant.	The Rev. G. Gleig, Chaplain-General.

DONATIONS.

Among the more important Donations presented to the Institution since the Annual Meeting were—

To the Library.

The Catalogue and Reports of the Paris Exhibition ; presented by H. M. Government.

Dictionnaire de Bayle, 4 vols. ; presented by Capt. Packe.

The Linesman ; presented by Colonel Napier.

Observations on the Purchase System.

Is England a Military Nation or not ? presented by Sir Robert Gardiner.

Histoire de l'Armée Française, 4 vols. ; presented by Colonel Raban.

Address to the East India Company's College at Haileybury, and Examination of Students at Addiscombe ; presented by Colonel Sykes.

Catalogue of Stars near the Ecliptic ; presented by E. Cooper, Esq.

Meteorological Register of Madras, and Astronomical Observations 1843 to 1852 ; presented by the Hon. Court of Directors.

The Transactions of Various Societies, &c.

Maps and Plans.

Map of Mahon ; 5 Maps of Gibraltar at the Siege ; presented by Col. Paschal.

Plan of Kertch—of Scutari—of the Battle of the Tchernaya—of the Camp at Aladya—of Galala Bunen—View of Balaclava—Series of Eight Plates, showing the Construction of the Docks of Sevastopol—Fac-simile of an Annexe to Protocol of Paris ; presented by the Topographical Department of the War Office.

Medals.

A Silver Medal to celebrate the Siege of Gibraltar; presented by Col. Paschal.

Miscellaneous.

A Portrait of Lord Nelson and of the Duke of Wellington, with autographs.

A Medallion of Sir John Franklin; presented by John Barrow, Esq.

Pieces of Russian ration bread—Russian Soldier's Spoon, with blood in the ladle—Cap Pouches—Piece of fuse, which had been lighted to blow up the Magazine in the Redan—Russian Bayonet. Presented by Major Julius Raines, 95th Regt.

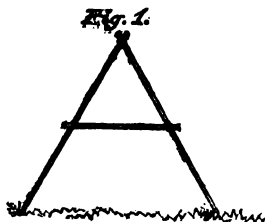
ON MILITARY SURVEYING AND RECONNAISSANCE.

BY CAPTAIN BAILLIE, E.I.C.S.

(*Abstract of Paper.*)

CAPT. BAILLIE commenced by observing, that he would take for the text of his remarks the recent Order of H.R.H. the Commander-in-Chief, on the qualifications for staff-officers, especially those of the Assistant-Adjutant-General's and Quartermaster-General's departments, which Order he read to the meeting. He would confine himself to the description of the purely practical methods of military surveying, such as it was within the power of every officer to make himself acquainted with, and which he should be able to apply at any time and under any circumstances, when called upon to do so. Military Surveying might be divided into two branches: 1st. Surveying with Instruments; and, 2nd. Without Instruments. The former was the easier and more correct method; the other being the result only of considerable practice and experience, and limited in a great measure to favourable circumstances of ground and locality generally. Surveying instruments might be classed as, those for linear, and angular measurement. Instruments for linear measurement were required to determine the length of a base line—which was the foundation of every survey,—and upon the correctness of which, the value of the whole directly depended. In military surveys, sufficient importance was not usually given to this the preliminary operation. In books on the subject it was rather slurred over; or they contented themselves with noticing one or two means of performing it—usually by the number of paces of a man or horse. Both these methods were very uncertain—the latter especially so.

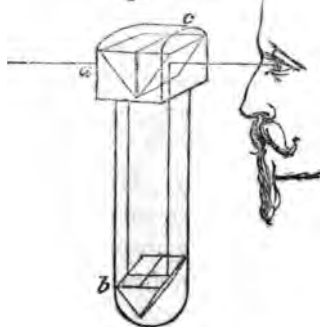
Every staff-officer had usually two or three chargers, all probably differing in the length of pace, and each, again, varying its pace under peculiar circumstances. Then it was difficult to count any high number of paces while at full speed, and while, of course, the attention must necessarily, also, be diverted to the direction of the line, and the nature of the ground. Perhaps time furnishes a better mode of estimating distance,—the rate of speed of a cavalry charger being about 400 yards per minute. The other mode of measuring offered a better criterion,—the foot pace. But even this was uncertain. No two men, hardly, however well drilled, took the same number of paces in 100 measured yards, marching independently; and no single man made the same number three times running,—and, when it came to broken and irregular ground, it was of course still less to be relied on. It was therefore of great importance to obtain some simple means of measuring a base “instrumentally;” and the one he (the lecturer) had found the most convenient, was the ordinary pace-stick, with the use of which every drill-serjeant or corporal was well acquainted, by means of which they could measure any distance as rapidly as they could walk, and with the certainty of unvarying length of pace. It was equivalent to the process of “stepping” measurements on paper with the compasses, which till lately had been the only means of dividing straight lines for scales and circles, even of large astronomical instruments. A simple pace-stick could always be constructed with three rods fastened together in an equilateral triangle with two sides continued, as in the fig. (1); or a jointed one could be made by any regimental



carpenter or armourer, and carried as a common walking-stick. There were other instruments especially adapted for measuring distances—such as the perambulator; and various optical instruments

—as the “stadium,” and the “rochon,” or micrometer telescope. The perambulator was well adapted for route surveys, but was too cumbersome for an officer to carry about with him. In India, a very large one, twenty feet in circumference, usually accompanied the head-quarters of each army. The perambulator might be usefully applied to gun-carriages. They had been frequently tried in ordinary carriages, but failed there on account of the springs, as there was a difficulty in connecting the parts on the wheel, from which the motion was derived, with those on the body of the carriage, where the dial or register was placed. Gun-carriages had no springs, and the objection, therefore, would not apply to them. One perambulator in each troop or battery would be useful; and on fair ground it would easily give a short base from which to ascertain distances for range. The micrometer telescopes were good, but, generally, too expensive for common use. One had recently been produced, which might be referred to, as it differed from all the others in the construction of the telescope, which was on a new principle. It was called the “Napoleon III.” field-glass, invented by a French officer, M. Porro, who sought to combine in it the long focal length of the old draw-telescopes with the more compact form of the modern double field-glass. He had done this very cleverly, by folding up the length as it were into four, on the principle of the “optical paradox,” only that prisms were substituted for reflectors: the diagram represents the instrument. And it was evident that a ray of

Fig. 2.



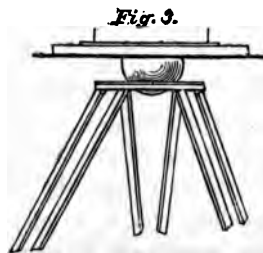
light, entering the telescope through the object-glass or prism at A, would be refracted thence up again to C: and so to the eye. The micrometer was engraved on one of the prisms. The instrument

combined great steadiness with long focal distance and large field of view. The cost in Paris was about six pounds.

We will suppose that by either of these methods we have succeeded in measuring a base line; the next point is to select the stations for the various triangles which form the net-work of the survey. The equilateral is the best form of triangle for this purpose, and the angles should never exceed 90° or be less than 30° , as extremely obtuse or acute angles are liable to considerable error. The choice of the marks of the different stations must of course depend upon the nature of the country; they may be trees, prominent rocks, and stones; or buildings, spires, towers, chimneys, &c., afford good marks; but angles of buildings and walls should be avoided, as they are often concealed or undistinguishable from the contiguous stations. In some cases it may be necessary to use artificial marks entirely; the best of these are those which, on the principle of the "Heliotrope," or as it is more correctly called "Helio-stat," reflect the sun's rays to the observer, and thus afford a brilliant object visible at immense distances. The helio-stat, as used in trigonometrical surveys, is a circular bit of looking-glass about six or eight inches in diameter, whose surface is a true plane; it is fitted into a brass frame, and supported on a horizontal and a vertical axis, so that it can be turned in any direction, either of azimuth or altitude, for military purposes. However, this would be a great deal too complicated and cumbrous; all that we require is a common "shaving-glass," or, if that is not available, the lid of a tin box, or a tin plate or canteen, polished up with sand for the occasion. An orderly might be sent to the distant station with this, and directed to stick up his sword or a ramrod between himself and the position of the officer who is observing the mark, and by keeping the sun's rays playing upon the end of the ramrod or the hilt of the sword he will be enabled to direct them very accurately to the point of observation. The observer may have another mirror at hand, and, by flashing it a certain number of times towards the signal-man, he could convey any simple directions that might be necessary. Persons who are not acquainted with the use of mirrors in this way will be surprised at the immense distances at which the reflected light is visible. In the Ordnance Surveys a helio-stat has frequently been observed at distances exceeding 100 miles; and at the Cape

one of only three and a half inches in diameter was almost too brilliant for the telescope at 80 miles' distance. Mr. Galton, in his very valuable and interesting little work on the "Art of Travel," mentions that this plan of communicating signals is used on the plains of Australia and the prairies of America, and suggests its great value to shipwrecked sailors in open boats or rafts on the sea, where their signals are often overlooked. The same principle was also adopted by the Russians at Sebastopol as a telegraph.

We will next proceed to consider the means of measuring the angles and bearings of our station-marks. The earliest and simplest instrument for this purpose was the "plane-table," and, as it is still in use, it may be as well to describe it. It consists of a square wooden frame, or board, upon which a piece of drawing-paper is stretched, and which is supported on a tripod stand. In order to observe an angle or bearing, a flat rule furnished with two brass sights is provided, which sights are adjusted to coincide with the object to be observed, and a line drawn along the edge of the rule gives the required bearing. Formerly plane-tables were very complicated instruments, and in some of the old books on surveying they are represented with every imaginable contrivance of sights, telescopes, compass, protractor, levelling screws and levels, which were supposed to render them perfect, but in reality were only additional sources of error; but it was soon found that the mere expansion and contraction of the paper from hygrometric causes, was sufficient of itself to produce an error of one-half per cent., and consequently no great dependence could be placed upon it, except for small spaces. For military purposes, however, where great accuracy is not required, it is still very useful; and one of the most convenient methods of making and using it is given in the Fig 3. For the table itself a

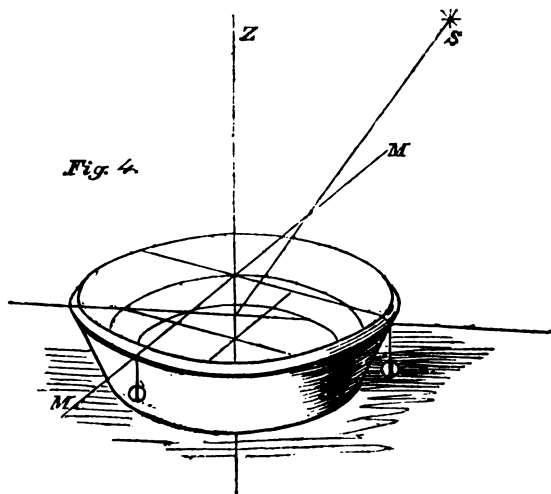


common block "sketch-book" is substituted, to which, underneath, is fastened a portion of a ball of common wood; this rests upon a tripod-stand, in the brass top of which there is a circular orifice (about two inches in diameter) to receive it, and forms with it a ball-and-socket joint, which admits of the surface of the sketch-book being placed truly horizontal. A flat wooden ruler with two needles fixed upright at the extremities, forms the sight ruler, with which bearings are observed and at once protracted. This is all that is requisite, and answers every purpose of the most complicated and expensive affair that can be produced by the mathematical instrument makers. The stand is the same as those now in such common use with photographic cameras, and has only lately come into use in England, but has long superseded the old folding tripod in India for all surveying purposes, and is superior to it from its greater stability. It can be made up anywhere by the commonest carpenter, and is equally useful for the compass, sextant, or telescope.

The next instrument for observing horizontal angles or bearings is the prismatic compass. It is so well known that any description of it is unnecessary. It was invented by Captain Kater for magnetic observation; but, from its portability, and the facility with which bearings could be taken by the "prismatic" arrangement, its advantages over the old circumferentor, or compass with sights, were speedily acknowledged, and it has quite driven that instrument out of the field. The compass card is usually divided to 180° on each semicircle; this, however, is objectionable, and liable to produce error in observation, and the card should in all cases be divided to 360° all round. A ring of silver is sometimes substituted for the card, but this only increases the expense considerably without any adequate advantage. The compass should always be provided with a stand like that of the plane-table described above. This is essential; for, although under very favourable circumstances a bearing may be taken to within 4° or 5° when the compass is supported in the hand, such bearings can never be relied on; the least wind disturbs the observation, and, in general, the angle between two objects can be much better estimated with the eye alone. If the compass must be used without a stand, the safest plan is to place it on the ground, and, standing over it, to align the sights upon the distant object, and then, kneeling down, to read off the angle without

disturbing the compass ; this always gives a much closer reading than the other method of holding the compass in the hand, when the very effort of steadying the body and the instrument produces a vibration that entirely precludes accurate observation. Another great source of error arises from the hair-sight of the compass not being truly vertical, which is another argument in favour of the necessity of the stand. In most works on military surveying it is said that the card levels itself, and, consequently, no other levelling is necessary—but this is erroneous ; it is not the card which is directed to the object, but the hair : and as it is frequently necessary to observe an object at a considerable height above the plane of the horizon, a very slight obliquity of the hair in this case will produce an error in azimuth of nearly 8° or 10° . Another irregularity of common occurrence, but which is very frequently overlooked, is that produced by what may be called local attractions caused not only by the presence of iron and other elements of disturbance in the earth itself, but, even in flat countries, by the vicinity of large masses of matter, such as houses, trees, &c., which exercise a direct and important influence on the magnetic needle ; and smaller bodies of iron especially, which, from their vicinity, have almost an equal effect. It has been found that an observation of a star (Polaris for instance) will differ as much as $1\frac{1}{2}^{\circ}$ from the reading with the same instrument, and of the same object, taken on opposite sides of a house ; and an even greater error would be produced by the proximity of a steel scabbard or sword, a bayonet, or even a bunch of keys, or a knife in the waistcoat pocket, which, perhaps, few officers would think it necessary to leave behind them on a surveying expedition. It is necessary in using the prismatic compass over large tracts of country to be able occasionally to observe the magnetic variation, or, as it is now more commonly called, the declination ; this may be done either by direct observation of the Pole-star at its elongations, or by finding a meridian line and comparing it with the magnetic meridian as indicated by the compass needle. Both these methods are described in most works on surveying ; but there is another, which is very little known, and which, as it is applicable to many useful purposes in surveying, might be described here. It might be called a simple transit

instrument, for it, when properly adjusted, would give the time by the transit of a star, or of the sun, with nearly as much accuracy as the largest and most expensive instrument for the same purpose. It consists merely of a vessel of water, mercury, or other fluid, over which two hairs or threads are stretched at right angles to one another as shown in the figure (4). It is evident that a star or



other object reflected from the surface of the mercury so as to be bisected by one wire, and its reflected image must be in a plane vertical to the surface of the mercury, and also of the earth at that point; if, then, the direction of the hair could be made to coincide with the true meridian at that place, the star, when bisected, must be upon the meridian, and the time then noted would be its time of transit. To make the hair or wire coincide with the meridian, it is only necessary to obtain sidereal time at the place, which could be immediately obtained approximately by noting the time of transit of a star at or near the zenith of the place (as shown by the reflected intersection of the wires in the mercury), when it must also be near or on the meridian. The right ascension of the star, as given in the Nautical or other almanack, would be the sidereal time of its transit, from which the time of transit of any following star could be deduced; and by moving the wire round, so as to bisect the star at that moment, it would be brought accurately into the meridian, or,

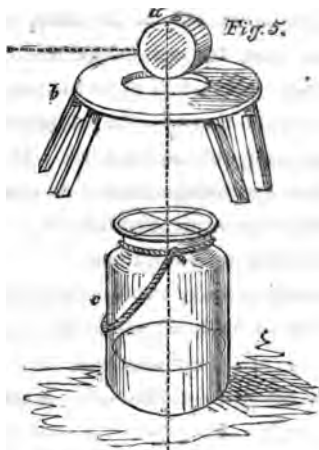
if not quite accurate by one operation, it would be perfected by repeating it. Then by arranging the compass over the vessel of mercury, with its small mirror inverted, we can easily compare the magnetic with the true meridian, and at once obtain the magnetic declination at the place. It may be noticed here that the simple transit instrument here described forms the best sun-dial or meridian instrument that can be constructed; once brought truly into the meridian, it indicates the moment of the sun's meridian passage to a second. In conjunction with the box-sextant it also gives the sun's zenith distance, from which the latitude can be obtained; it is besides applicable to levelling or contouring with the sextant, as will be hereafter described, so that it forms what might be almost styled an universal instrument most invaluable to the military man.

The box-sextant is the next instrument ordinarily employed for military surveying that may be noticed here. It differs from the ordinary sextant only in being smaller and more portable, from its being encased in a box, from whence it derives its name. In general they are divided only to half-degrees, and furnished with a vernier, by which a reading to one minute may be obtained; and, with a little practice, even half a minute may be estimated. They are frequently provided with a telescope, but this is necessarily so small, as only to complicate the instrument, without being of any advantage. It is curious that this instrument is almost unknown out of England, and the writer recently met a French officer in the Crimea, who was exhibiting one, found in the Redan, evidently the property of an English officer, with the use or even purpose of which he was entirely unacquainted, as well as many officers of his own service to whom he had shown it. The method of using the sextant is given in all works on surveying, as well as its adjustments. These should be meddled with as little as possible; nothing tends to destroy any surveying instrument so much as the constant attempt to preserve it in perfect adjustment. This is really impossible; and all that can be done is to observe the index error of the instrument before or after each series of observations. It is necessary also to be cautious into whose hands surveying instruments are entrusted. He (the lecturer) had on one occasion lent his box-sextant to a gentleman whom he imagined was acquainted with the method of

using it, and who returned it to him shortly afterwards, with the observation that "he had wound it up at both holes, but could not make anything of it." There is an objection to the use of the sextant in surveying—that it does not give horizontal angles, and that a complete series of angles round a station might considerably exceed or fall short of 360° . A little practice, however, would generally enable an observer to select a point above or below the distant station-mark in the plane of the true horizon; and by observing large angles, with long sides, the errors could never exceed those of the prismatic compass in the same circumstances. The effect of an error of one minute in the observation of a station-mark ten miles off would only amount to fifteen or sixteen feet, and for shorter distances it is much less; so that in a military survey, where great accuracy was not required or expected, this objection might be passed over. Each observed angle should be carefully noted down at once in the field-book. But, as even that gave room for mistakes, they should be distinguished by letters—A, B, C, &c.—and roughly plotted on the sketch-book at the same time; and in this should be inserted remarks and sketches of the nature and appearance of the station-points and marks, which would greatly assist the memory in completing the finished plan for submission to the authority for whom it was intended. In general, the unassisted memory should be relied on as little as was absolutely practicable. In the hurry of a rapid reconnaissance, points of the utmost importance would be overlooked or forgotten if left to the memory; while the most trifling pencil-scratch or note actually made on the ground, would help afterwards to recall the scene, and connect the various features of the sketch.

In all field-sketching of this nature, the delineation of irregularities of surface, such as hills, rocks, and broken ground, is the point to which most attention should be paid. If these are carefully laid down, the other features, such as roads, rivers, villages, &c., easily fall into their proper places; and it is precisely the point in which the memory can afford least assistance. The best method of observing differences of level is by running a few contour-lines round the hills at different altitudes; and the sextant is an excellent instrument for this purpose, as by a simple con-

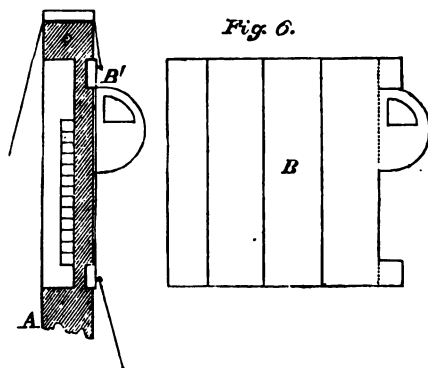
trivance it makes a perfect levelling instrument, which is shown in the accompanying diagram (fig. 5). *a* is the sextant, supported



at the height of the eye by the stand (*b*) merely to steady it; *c* is a common glass-bottle with a large mouth (a pickle-bottle answers the purpose excellently), containing sufficient mercury to cover the bottom of the bottle completely. Round the neck of the bottle a piece of thick cord is fastened with a loop to carry it by, and over the mouth two cross threads, hairs, or wires, are fixed, with sealing-wax or resin, at right-angles to one another. There is also a tin or paper cap to the bottle to protect the mercury from dust, &c. when not in use. The bottle is placed directly beneath the sextant, so that, on looking down through the top of the stand, the wires and their reflected image in the mercury may be brought into exact coincidence when the eye must evidently be directly vertical to them. If, then, the sextant be set to 90° , and interposed between the eye and the wires, so that they can be seen through it, any object seen in coincidence with the wires in the half-silvered mirrors of the sextant must make with them an angle of 90° , and consequently be in the true plane of the horizon at that place. Suppose such an object were the sight-vane of a levelling-staff, then the indication on the staff would be the difference of level between the station of the staff and the point of observation, + the height of the

eye at *a*. In this way a contour-line could be run in about one-tenth of the time that would be required were the spirit-level used, as the mercury quickly comes to rest, and from the shape of the bottle the wind can have little or no effect upon it. It has also another advantage over the spirit-level in levelling down a steep slope, where a single observation gives the angle of elevation or depression, which could otherwise be obtained only by repeatedly setting up and removing the spirit-level. This "sextant-level," in other arrangements and modifications, is also available as a dip-sector, zenith-sector, and vertical-collimator,—but it is unnecessary here to enter into a description of them.

As a levelling-staff, or even two or three, is required in contouring, a simple one is given here, which has been found convenient, and which may be made up almost in any position where a deal rod and a piece of tin can be obtained. *A* (fig. 6) is the levelling-



staff—a common deal rod, about 10 feet long by $1\frac{1}{2}$ inch square, in section—it is divided to feet and tenths of feet, in preference to inches. *B* is a sheet of tin cut out in the form given, so as to fold round the staff, and form a sliding vane. On the part which overlaps, a vernier-scale is made, which enables the staff-man to read the height of the vane to 100ths of a foot. The vane is moved up or down on the staff, according to signal from the observer, by a thin cord running freely through a hole or over a pulley in the top of the staff. The vane being of bright tin can be seen at great distances.

It has been already observed, in the commencement of this paper,

that sketching without instruments can only be acquired after considerable practice and experience. Indeed it is impossible to lay down any rules for it, as the method of making the survey must vary for every locality, and depends entirely on the nature of the distinguishing features of the ground which is the subject of the survey. The usual method was to select the prominent elevations of the ground for stations, and from these to sketch out as much of the ground as could be seen from them, noting especially the points of intersection of the lines connecting the principal stations with each other; in this way a network of triangles was formed, as in a trigonometrical survey, which confined the errors of the position of the features of the ground within certain limits; and it was on the frequency of these intersections that the accuracy of the survey depended.

In conclusion, it might not be amiss to add a few remarks on the delineation of ground in military drawing. This must be always in a great measure conventional, because no merely pictorial representation of the surface of a tract of country, as seen in plan, could afford any indication of its absolute elevations or depressions. It was necessary to introduce shadows, and to exaggerate these even considerably, to produce the appearance of relief, and, where the brush was used, to depict ground. This method of delineation was undoubtedly the most perfect, but it was necessary at times to use the pen instead of the brush, and hence arose the two methods of representing hills now in common use, called respectively the horizontal and vertical methods. These are best described by reference to the effect of water upon a tract of hilly ground. In the vertical method the strokes or hatches of the pen represented the direction which would be taken by water or rain falling upon the top of the hill and running down to its base; the lines or hatches were, consequently, always perpendicular to the "water-shed." In the horizontal method the strokes of the pen represented the lines or "contours," that would be produced by the subsidence, at regular intervals, of a large body of water which has completely covered the hill; the strokes are, therefore, generally parallel to the "water-shed." A good practical illustration of this mode of representing hills was afforded by the "parallel roads or terraces" of Glenroy, in the High-

lands of Scotland, supposed by geologists to be ancient "sea-beaches." Till of late years the vertical method of shading hills was the only one acknowledged and practised in the British or Continental armies; but recently the improvements on the horizontal system, or rather the adaptation of it to "contouring," have rendered it so superior to the other that it will probably entirely supersede it. In the French army this was already the case, and in their topographical department the "contour" system was solely used for the delineation of hills. The relative advantages of the various methods would be better understood by an examination of plans executed in the different styles (which were exhibited during the lecture). Mr. Wyld's Atlas of Battles in the Peninsula showed some good specimens of brush-work (lithographed); but in these the shadows were generally so exaggerated that it was difficult to make out the movements of the troops which they were intended to illustrate. The Plan of Sebastopol, published by our own topographical department, was a specimen of the vertical method; and a plan of the same place, from a French work (the *Journal des Sciences Militaires*), illustrated very beautifully the superiority of the "contour" method, as with a knowledge of the vertical distance of the contours the relative height of any object, and its absolute height above the sea-level, was immediately obtainable. In contrast to all these, some beautiful photographs from a model of a part of the Alps (Monte Rosa) were exhibited; these might be said to illustrate the "pictorial" method, entirely divested of all conventionality, and might be taken as a standard of excellence in brush-work, as the flat shades of the photograph could only be imitated by the brush. A comparison of the conventional methods was decidedly in favour of the contour system as used by the French, without shading of any description; and too much attention could not be directed to the study of this method. It afforded also a very simple method of modelling from Nature, as, if these contours were each traced separately on pieces of cardboard, cork, or similar material, and then cut out and built up in their proper positions, they at once furnished a correct model of the general surface of the ground delineated in the plan. The recent introduction of sand-modelling into our Military Colleges must also prove of immense advantage to young

officers in acquiring a rapid knowledge of ground—in its relation to military purposes. A beautiful specimen of modelling in this style was to be seen at the E.I.C.'s Military College at Addiscombe in the representation of "Ehrenbreitstein and Coblenz;" and it was to be hoped that this system of practical education would be speedily adopted in all our military schools, as, next to actual field-sketching, it was only by the study of models that a young officer could hope to attain real proficiency in Military Drawing.

The Lecture here concluded, but in the discussion which followed some interesting remarks were made by Mr. Galton and General Bagnold on the subject.

Monday, 1st June, 1857.

Colonel the Hon. JAMES LINDSAY in the Chair.

ANNOUNCEMENT.

The CHAIRMAN said,—Before we proceed to the business of this evening, I have a communication to make to the Members of the Institution respecting the Model of Sevastopol; and, in order that the course which the Council have taken for the purpose of obtaining the most accurate representation of the theatre of the late war may be placed before you as concisely as possible, a Memorandum has been drawn up, which the Secretary will now proceed to read.

MEMORANDUM relative to the MODELS of the SIEGE of SEVASTOPOL and of the surrounding Country.

In the month of November, 1855, His Royal Highness Prince Albert signified his intention of presenting to the United Service Institution a Model of Sevastopol and of the South of the Crimea. In doing so His Royal Highness made a condition that the Council would take steps to mark in colours, or otherwise, as might appear most advisable, the exact position of the Allied Attack and Russian Defences at the time of the capture of the place, and he hoped that the opportunity would not be lost of acquiring and preserving in a public Institution a correct Model of the Siege.

The Council most thankfully accepted His Royal Highness's offer. The Model was a Cast of one which had been made by Mr. Wyld in the early part of 1855, and which was at that time the only representation in relief of the South of the Crimea then in England, and in that respect was most valuable; but it had been made chiefly from Maps which were in existence before the War commenced, and before any general accurate survey had been made by British officers; and, though it gave with a fair degree of accuracy the general position of the towns and villages and the principal hills, it was found, when the survey of the trenches of the Allies and the works of the Russians was correctly laid down by our own officers, that it was impossible to transfer them on to a model which had not the advantage of being made from such correct data; and therefore, with every anxiety to act up to the spirit of His Royal Highness's wishes, the Council were unable to do more than mark in a temporary manner the positions of the Camps of the Allied Armies.

Colonel Hamilton of the Grenadier Guards, who had surveyed a portion of the ground in front of Sevastopol, had, at the request of the Council, undertaken to superintend the completion of the Model; but, being ordered upon duty to Dublin, he was unable to take any further steps in the matter until the spring of this year.

In the mean time the official surveys of the corps of Royal Engineers and of the Quartermaster-General's Department had been completed, and other valuable sources of information had become known. It was, therefore, thought that the wishes of His Royal Highness would be most thoroughly carried into effect by making an entirely new model, instead of attempting to correct a portion of that at present in the Institution.

At the meeting of Council on the 4th of May, Colonel Hamilton submitted the following proposal: That an entirely new Model of the Siege of Sevastopol and the surrounding country should be constructed, and that a second Model should also be constructed on a much larger scale, showing the advanced part of the Allied Attack and the Russian Defences.

The Council were also informed that His Royal Highness had expressed himself as most anxious to co-operate in any plan that they considered most likely to carry out the object in view.

The Council therefore recognising the advantages of possessing in

the Institution, for the use and study of its members, the most correct and complete Models which the united efforts of the Officers of the Naval and Military services could procure, adopted the proposal submitted to them by Colonel Hamilton, and requested him to superintend their construction.

One Model, on a scale of 1 inch to 480 feet, will comprise the whole country from the River Belbec to Balaklava, and from Kamiesch to Tchorgoun. It will represent—

1st. The positions of the English, French, Sardinian, and Turkish Camps.

2nd. The Siege Works of the English and French Armies.

3rd. The Russian Defences.

4th. The several Battles fought during the progress of the Siege.

5th. The Railroads and various Roads of Communication.

6th. The Intrenchments of Balaklava.

7th. The position of the Allied Fleets off the Harbour at the close of the Siege.

8th. The Soundings round the Coast, from the Admiralty Surveys.

9th. The Northern side of the Harbour as far as the River Belbec and the McKenzie Heights, with the position of the Russian Army.

The second Model will represent on a considerably larger scale the Russian Defences of the Town, with the Advanced Portion of the attacks of the Allies.

Officers possessing Surveys or Sketches of any part of the above country, and who are willing to afford such information as will tend to make the above Model still more complete, are invited to communicate with the Sevastopol Model Committee at the Institution.

The following Officers have consented to form a Committee and superintend the construction of the Models:—

Colonel F. W. HAMILTON, C.B., Grenadier Guards.

Captain MOORSOM, C.B., Royal Navy.

Captain FOWKE, R.E.

Captain Hon. GEORGE WROTTESELEY, R.E.

Captain ELPHINSTONE, R.E.

Lieutenant DONNELLY, R.E.

EDWARD JEKYLL, Esq., late Captain, Grenadier Guards.

NEW MEMBERS.

The Chairman then announced that since the last Meeting 14 Officers had become Members of the Institution.

ANNUAL SUBSCRIBERS.

Lieut. B. Crowe, Field Train.	Lieut. Franklin, Roy. Art.
Capt. Vaughan Jones, Unattached.	Lieut. Walker, Roy. Eng.
Capt. Sir W. Wallace, Gren. Gds.	Lieut. G. Phillips, Gran. Gds.
Colonel Campbell, late Renfrew Mil.	Surgeon Murtoogh.
Lieut. F. Woodgate, 2nd Life Gds.	Lieut. Cuninghame, 2nd Life Gds.
Lieut.-Col. Wodehouse, Roy. Art.	Capt. Younghusband, Roy. Art.
Major Davidson, late Bombay Army.	Colonel Clark, Roy. Mil. Asylum.

DONATIONS.

The Report of the Commissioners on the re-organization of the system of Training Officers for the Scientific Corps; presented by H. M. Government.

Manuscript of Sir Erasmus Gower, with Observations on a Passage from England to India in 1782; presented by Lord Radstock.

Hand Book for Field Service; presented by the Royal Artillery Institution.

The Militia, and its Importance as a Constitutional Force; presented by Mr. Haggard.

The Traveller's Library, and Summer Tour in Central Europe; presented by John Barrow, Esq.

ON THE FORMS OF SHIPS WITH RELATION TO NAVAL GUNNERY.

BY CAPTAIN FISHBOURNE, R.N.

THE tendency of the human mind to swing into extremes is such, that it often becomes necessary to call it back from the too engrossing consideration of new discoveries, or of newly disinterred truths, to a consideration of points that may have been and are too often set aside for no better reason than that they are old and appear trite.

This, I contend, has most injuriously been the case in respect of the forms of ships, as compared with the number and character of the guns they carry.

Thus the number and character of guns that any two ships respectively carry are contrasted, and that one which contrasts most favourably in this respect, if she have equal speed, is declared, for

all purposes, to be the best man-of-war; yet, that she is always so is very questionable.

The question involved is important, and one not simply confined to forms of men-of-war, but may, in the present instance, be considered in reference to them. Its importance has never been sufficiently estimated, and it will assume greater value with every improvement in the construction of guns, and with each increase of skill in the mode of using them.

To place two rifles on an equal footing, and to obtain anything like a satisfactory proof of their relative value, it is necessary to fire them from fixed rests,—in fact, long range is of value just in proportion as the support from which the gun is fired is motionless.

Now, if this is true as respects guns whose effective projectiles range 600 or 800 yards, how much more important is it with respect to those in which they range 3000 yards or upwards!

As I am about to state heresies, it is right to caution my audience not to take anything on trust; but it may be permitted to refer to the fact that ten years since I advanced what were then deemed heresies in naval construction, yet the form of each new ship approximates more and more towards the lines then indicated, whether as the result of anything I may have said, or not, is of the smallest importance—the country has obtained the benefit; the fact alluded to, therefore, may be passed over with the remark, that, as I was not so wide of the truth then as some architects desired to make out, I may not be more so in the view I shall now set before you.

There has been a good deal of discussion as to the comparative efficiency of English and American men-of-war. One writer went the length of affirming that he would snap his fingers at many Niagaras if he were in the Duke of Wellington and had the power of motion.

Now, the position I take up is this, that rolling motions, in proportion as they are extensive and frequent, so entirely prevent precision of firing, that any vessel that has this fault, whatever may be her number of guns, or the superiority of their construction or calibre, will be unable to defend herself against an enemy very inferior in every respect but the one, viz. that of her motions being very much more limited in extent and rapidity.

This quality depends upon the fact of the greater or less degree of stability that the ship may possess. Stability may be defined to be

that property in a ship by which she resists inclination or motion round a longitudinal or transverse axis, whatever the disturbing force may be.

Stability is derivable from different causes:—

1st. From the low position of the centre of gravity as compared with the position of the centre of gravity of displacement.

2nd. From the dimensions and form of body, especially of that portion which is subject to immersion and emersion.

But the effects of form must be considered when in motion, whether round an axis or moving horizontally.

This divides itself under three different heads:—

1st. The amount of effect likely to arise, or arising, from a given steady pressure, or the amount of stability at a given angle of inclination.

This has been treated of by Clairbois and other writers, but with more accuracy by our countryman Atwood.

2nd. The amount of effect from a sudden pressure as compared with a steady pressure of equal amount.

This has been treated of by Professor Mozeley in a paper published in the Transactions of the Philosophical Society for 1850.

3rd. The effect produced by a variation of the surface of the sustaining fluid, moving, as it does, the point of suspension.

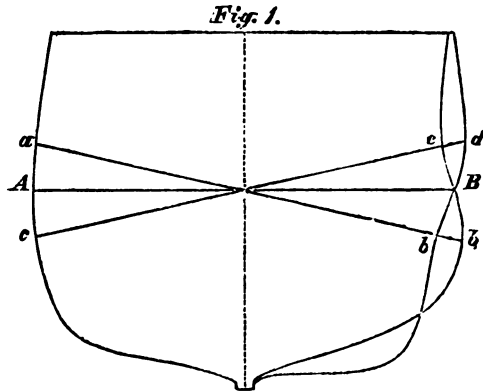
This last has not been, as far as I am aware, considered by any writer, and constitutes the immediate subject of this paper.

It will be necessary to state only so much of the views of these writers as will suffice to make my argument more intelligible.

The French writers took as the measure of stability the height of the meta-centre, determined for an infinitely small angle of inclination, which was liable to grave error, as it was only an approximate measure, and then only under certain limited conditions, as was pointed out by our countryman Atwood.

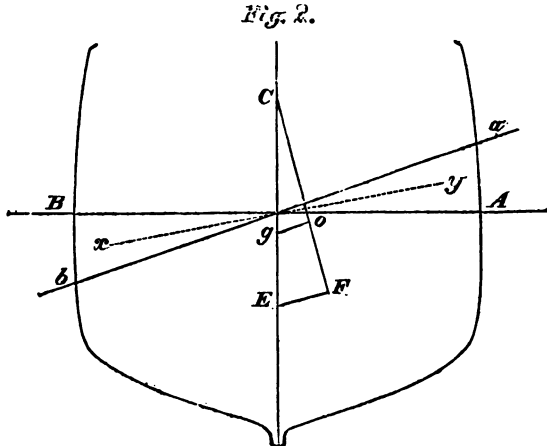
The following figure (1) will illustrate this defect.

Stability varying as the cube of the breadth. If the solids of immersion and emersion take the form e , B , b , then A , B , the breadth at the load water-line used in the calculation, will place the meta-centre too high, while, if it assume the form d , B , b , the calculation will place it much too low. In the first case the actual stability will be much less, and in the second much more, than the estimate.



Atwood suggested the propriety of estimating the stability or resistance to inclination put forth at a given angle as measured by the contents of the solids of immersion and emersion at that angle, the horizontal distance $x y$ of their respective centres, together with the total displacement.

From these $E F$ (Fig. 2) might be determined, and g , the position of the centre of gravity, being ascertained, $g o$, or the lever through which the displacement would act in his efforts to right the ship, or



to prevent further inclination, might also be ascertained. E is the centre of gravity of displacement when the vessel is upright, F is the

same when the vessel is inclined. AB the water-line when the vessel is upright, ba the same when the vessel is inclined.

This Professor Mozeley showed was not sufficient, as it did not embrace all the conditions required; thus, for instance, it did not embrace the question of stability in motion round a longitudinal axis.

He shows that the pressure which would retain a vessel at an inclination of ten degrees, if brought on suddenly, would, owing to dynamic action, incline her to nearly double that, and then occasion a series of oscillations when it did not overturn her.

His paper is a valuable contribution towards an elucidation of the subject, though some of his conclusions are contrary to known facts; he suggests what appears to be a very satisfactory way of estimating the stability, but only in smooth water, viz., by "the work done in raising the body a height equal to the difference of the vertical displacements of its centre of gravity, and of that of its immersed part." When the sea is the cause of oscillation "the work done" is a measure of the ship's instability rather than of her stability.

Though his reasoning is valuable in its place, it does not explain the facts observed, and fails on very important points, but only in common with all other modes of treating the subject.

The point in which they fail is in explaining the observed facts with reference to rolling.

All calculations on the subject proceed on the supposition that a ship is a species of compound pendulum, and subject only to disturbing forces acting horizontally, such as the wind on the sails; one class supposes a relatively fixed point of revolution, and that to be the centre of gravity, though ships do *not* revolve round their centres of gravity, as has been so generally supposed; the other supposes a vertical motion of this point, but only in proportion to the angle of inclination, and to the size and form of the immersed and emerged solids, the *effect of a horizontal force*.

The latter alone is correct, but then only in perfectly smooth water. Each writer overlooks the fact that the normal state of the sea is motion, hence called "the troubled sea," and that the rolling motions are due with scarce an exception to this rather than to any horizontal impulse whether of wind or wave.

I do not mean to say that there is not the slightest analogy at any time between the oscillations of a ship and those of a pendulum, but that there is a manifest difference in the fact that the latter has a fixed point of suspension, and in that the oscillations are produced by a horizontal force which moves the pendulum from the perpendicular, while the former has a moving point of suspension, which is the direct occasion of the oscillations of a ship.

The facts observed not being explainable on the principle of considering a ship's motions strictly analogous to a pendulum, establishes that some other hypothesis is required.

Professor Mozeley, alluding to the *Canopus*, *Bellerophon*, and *Vanguard*, says "the latter should therefore be the least stable of the three." p. 635. Yet this we know is not the fact as respects a horizontal force—the only kind he treats of.

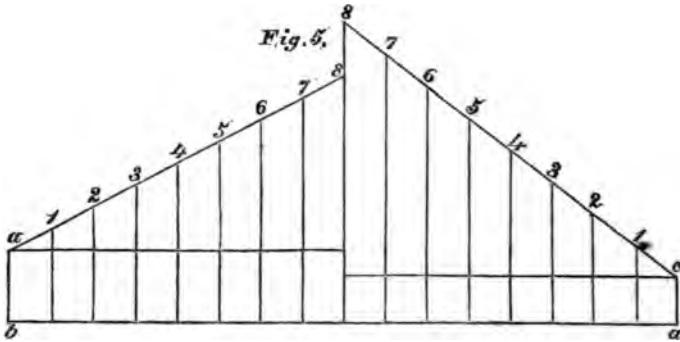
Again he says, alluding to vessels of the *Canopus* and *Vanguard* type, "the former roll more quickly than the latter, but do not roll so far, so that, unless some special provision be made for that end, stability in rolling may not, and will not, probably, be obtained, except at the expense of quick rolling." p. 638.

These conclusions are consistent with the supposition of the strict analogy to a pendulum, but they are contrary to fact. For vessels of the *Canopus* type do *not* roll faster than those of the *Vanguard* type.

Thus the *Rodney*, of the former type, rolled only eight times, while the *Albion*, of the latter, at the same time and place nearly, and under similar circumstances, rolled thirteen times; yet the *Rodney* rolled through an arc of only 27° , while the *Albion* rolled through 49° . Similar facts were observed of the *Canopus* and *Vanguard*, and other vessels of their respective types.

Professor Mozeley treats the question as one solely dynamic, and as a question of relative stability at a given angle of inclination, and supposes that a ship may have greater absolute stability while she may have less relatively to a given angle of inclination.

This may be represented by the following diagrams, in which a , b , may represent the absolute stability of *Vanguard*, and c , a , that of *Canopus*; but, as each increment of stability put forth at each additional angle of inclination may be greater in the *Canopus* type,



therefore at 5, 6, or 7° of inclination of each class, the stability of the *Canopus* type would be greatest.

This no doubt may occasionally obtain, but does not under the circumstances in the class of forms he gives, for, as I have shewn, he states that the *Canopus* type is of a more stable form than the *Vanguard* type; yet we know that in smooth water the reverse is the fact, though no doubt, as Professor Mozeley shews, if both were inclined to indefinitely large angles, vessels of the *Vanguard* type would be first upset.

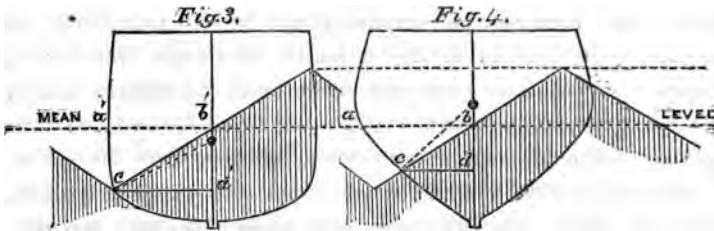
The defect in his reasoning is from treating the greater or less arcs that ships roll through as a dynamic question simply, when in reality it should be viewed as a statical question primarily, in which no doubt dynamics subsequently, and increased action, are involved in an amount proportionate to the statical action.

Waves are the cause of rolling motion, and they are the result of a vertical motion of the particles of water which constitute them—they only have a horizontal motion, not the water, except to a very limited extent, and only occasionally.

This vertical motion commences at and is greatest at the surface, and vanishes altogether at limited depths, varying according to the height of the wave above the mean level; consequently that form of vessel in which the area of load waterline is greatest, as compared with her total displacement, will, in proportion, be subject to more rapid and more extensive motions,—will, in fact, be more sensitive to every agitation of the sea, and afford a less stable platform for guns.

Facts illustrative of the truth of this will at once occur to the

minds of my audience, more particularly those who have ever belonged to a flat-bottom vessel of little draught,—the extent and rapidity of the motions of such vessels under certain states of sea are nearly intolerable. But to those who have not had such experience, and further to illustrate the case, we may assume two sections, which may be taken as characteristic of the general form of



each. Let it be supposed that two waves of equal dimensions are passing across these sections, their crests having passed along the dotted line in the figures.

I have already stated that the motion of the particles of water constituting the waves was vertical; consequently, the forces these vessels are subject to under the hypothesis are the vertical action of the wave, acting through two-thirds ab and $a'b'$ (the half-breadth) respectively, tending to cause rotation, and the resistance to immersion offered by the other side, acting through two-thirds cd and $c'd'$, but, as in Fig. 3, the levers through which these forces causing and resisting rotation are equal, rotation takes place only because the force which tends to produce it is greater than that which resists it; not simply so in the case of Fig. 4, for not only is the disturbing force greater, but this greater force acts through double the lever, ab being nearly double that of cd ; the weight of the bodies represented by Figs. 3 and 4 being equal, and the power applied to Fig. 4 much greater, much more rapid motion must result in her case. Further, whether we suppose the ships homogeneous solids or similarly stowed, the centre of gravity of Fig. 4 would be much higher than that of Fig. 3, and for that reason also would incline more; in other words, her centre of gravity would require to be raised a less quantity than that of Fig. 3 before she were overthrown.

These figures shew the tendencies rather than the actual circumstances that occur, but the argument remains untouched by this; and, as these tendencies give the direction and an estimate of the motions which do occur, it appeared the most simple if not the most correct way of shewing the causes, and illustrating their consequences.

If a line be drawn in each from the centre of gravity to the outer edge of the immersed half-breadth, it will be seen that Fig. 3 will require to be inclined through a much larger angle than Fig. 4, before a perpendicular from that centre would be brought without the base of support,—in fact, Fig. 3 would require to be much more inclined, before it would be overthrown, than Fig. 4.

But now we have to deal with an important dynamical question, which, in its effects, aggravates the faults already dwelt on, for, when the disturbing force is more than is necessary to give the initial velocity, the excess of this force over the resistance to motion is accumulated under the form of *vis viva*; now the excess in Fig. 4, as we have shewn, would be greater than that in Fig. 3 in the inverse ratio of two-thirds of the cubes of their respective half-breadths. But the effect of this *vis viva* is to continue the motion communicated, after the immediate disturbing force has ceased to act in the original direction, then the wave having passed the centre it would tend to set up a new action in the opposite direction.

Where these oscillations of the ship synchronize with those of the wave, the former will increase, and this synchronism will more nearly occur in proportion as stability is due to displacement at the load-water line, that is, when the disturbing forces are greatest, and the motion is least subject to any retarding influence, such as a low centre of gravity, and greater displacement where the water has least motion.

We have an illustration of the existence of a force such as I have described the *vis viva* to be, in the common custom adopted in rolling irregular shaped bodies by a limited power, that of oscillating the body backwards and forwards, and when the arc of oscillation is brought to a maximum to give it a final push, the result of which often establishes the fact of accumulated power.

Captain Nolloth mentions in his journal, published in the

Nautical Magazine, that it is more than probable that the fate of the *Nerbudda* was another illustration of the principle stated above, which was very possible, for she was of the type of Fig. 4, had very little ballast, and left Algoa Bay with a badly sprung mainmast.

The action of the masts is rather favourable in limiting the arcs in rolling, for, as the vessel rolls, they, by their inertia, tend to lag behind and to generate independent oscillations, which prevent those of the vessel from synchronizing with those of the wave; if then her masts went and she were broadside on to the sea, a very possible contingency under such circumstances, the more probable as the seas there are such that vessels are often prevented from answering their helm even with considerable way on, her oscillations will have increased each roll till she has rolled over; if on the edge of the bank, all the more probable, as she would have experienced a walled sea, with a strong current running to windward, all tending to the same fatal result. Similar results nearly occurred to the *Star*, the *Raleigh* (sloop), the *Racer*, and the *Magpie*, all of a similar type, which shows the necessity of giving them more ballast and the propriety of not building any more like them.

We have seen that two vessels of similar capacity, differing only in form and distribution of weight, but only so far as their different form entails, are very different in the most essential quality of a man-of-war, that of stability under the ordinary condition of the sea, and that therefore the efficiency of a man-of-war may turn more on the form than upon the weight of broadside she throws.

I may mention a fact illustrative of the different degrees of steadiness in two steamers, both paddle-wheel. Horses could not be carried in the *Hermes* without their being packed so close side to side that they should support each other, having their rumps against the bulwark, and trusses of pressed hay secured to spars placed against their chests, yet the *Birkenhead* carried them without even battens on the decks, while those of the *Hermes* were matted and battened also. But to return to the case of the *Niagara* and *Wellington*. The disparity in the number of their guns prevents the possibility of drawing a direct comparison between them as they are; yet, in very bad weather, the *Niagara* would prove herself an equal. For

First. The *Duke*, under such circumstances, could not avail her-

self of her lower-deck guns, and possibly not of those on her middle deck; and

Secondly. All her other guns would be much less effective from her rolling so much more than the *Niagara*.

But there is no reason why a vessel of the *Niagara's* dimensions should not carry main-deck guns, and be a steadier ship in consequence, in which case she would be a formidable adversary under any circumstances of weather, and should not now be despised, even by vessels of much greater nominal power.

It is manifest, that, under the circumstances of the *Rodney* rolling 20° one way and 27° the other, she could only have used her lower-deck guns occasionally, and then not without great care and some danger, as 15° or 16° inclination would bring the cills of these ports into the water, while it is equally manifest that the *Albion* could not have used hers at all, and thus, though she were a 90-gun ship, she would practically have been reduced to a 60, and these, owing to her more rapid and more extensive motion, would not have been equal to any 40 of the *Rodney's* guns; even the latter would be inferior to a 50-gun frigate of similar form at comparatively close quarters, and vastly inferior at a distance (which those in such a vessel could always choose), as each of her guns would be more effective than each of those of the *Rodney*, because her motions, she not having the weight of the second deck and guns, would be so much less.

The *Niagara*, with her present armament, but under the circumstance of weather, when these vessels were rolling, one 19° and 27° , and the other 32° and 49° , the former 8 times, and the latter 13 times in a minute, would possibly have destroyed either, but could undoubtedly have done so by the *Albion*.

The effectiveness of each gun, under the circumstances, would be in the inverse ratio of the number of degrees they roll through in a minute. Thus—

The *Rodney's* would be $19 + 27 \times 8 = 368$ to

In *Albion* „ $32 + 49 \times 13 = 1053$,

or the effectiveness of a gun in the *Rodney* would be to a similar gun similarly situated in the *Albion* nearly as 3 to 1.

In estimating the value of upper-deck guns, it should be borne in mind that the day is gone by when ships can run alongside each

other and pound away for hours, for the power and practice of gunnery is such, that, unless the ship's motions are very great, a few minutes at close quarters will suffice to settle the action—or one of the contending parties, if not both. It must also be borne in mind, that a good gun in a bad ship will be no more effective than a good rifle in an unsteady hand—the gun and the ship must be held as inseparable in any estimate that may be come to, as are the rifle and the man with his greater or less capabilities to use it: a blockhead will produce in the average as good results with “Brown Bess” as with an Enfield: no better results can be obtained in a ship whose motions are rapid and extensive, whatever may be the goodness of the guns or skill of the gunners. The disadvantage of these bad qualities are such, that if the opponents on the one side are without them, and all other things be equal, the action must be decided in *their* favour almost before they arrive within point-blank range.

Now upper-deck guns are not of much value for distant firing, nor of much value when close, when the object is much below them; and yet the effect of their weight, and that of the deck which carries them, is to increase a ship's rolling, and thus diminish the effectiveness of all guns below them—now, in proportion as a battery is more nearly *à fleur d'eau*, is it effective; and in the same proportion also, other things being equal, is the weight of its guns and deck less injurious in its effect on the motions of the ship; consequently, all upper-deck batteries should be sacrificed in part or wholly to perfect the most effective.

No doubt it is a mistake in the *Niagara* that her guns should be so high, but this is true of all steam-vessels that have only upper-deck guns; but this mistake obtains to a greater extent in two and three decked ships, as their rolling motions must be greatly increased by the weight of their upper decks.

It has been said, and not altogether without some truth, that large ships cannot compete with a number of gun-boats, and yet the bare assertion cannot be accepted as fact, for it may be safely affirmed that, except in the smoothest water, accuracy of fire from gun-boats so small and so formed as ours are, is out of the question—an estimate of them on this point may be obtained from a comparison of the effect of size alone.

The motions of vessels geometrically similar, with all their weights, that of hull included, similarly disposed, are as the squares of their lengths—the greater ship having the less motion.

Thus the motions of the *Duke of Wellington* would be only one-fifth those of one of the gun-boats, and those of the *Great Eastern* only one thirty-fifth of the same.

Nevertheless floating batteries could be designed, that, from their absolute steadiness of gun-platform, with four or six guns, would be more than a match for any of our block-ships; and, from their small draft of water, could take shelter from attacking ships, while, for the same reason, they could defend the shoal parts of our coasts, where block-ships could be of little or no service, and would cost vastly less than the latter.

But this opens the important question as to whether the three-decked ships are not a costly mistake. I confidently affirm that they are; for grant even much less dimensions than those of the *Duke of Wellington*, and a ship might be produced that should possess the qualities of speed, &c. possessed by her in a far higher degree, whether under sail or steam, and, though carrying a much smaller number of guns, would be as effective in smooth water, and vastly more effective in the ordinary conditions of the sea, and more effective in narrow seas, while she would have the further advantage of costing much less, both for a first outlay, and for current expense. No doubt her undue size, and that of others similar, is partly the result of having to use up timber that was cut out for ships like the *Queen*, on which they are certainly improvements, and the two-decked ships are still greater improvements on the *Albion* and *Vanguard*; but it will take many years to eradicate from our navy the evils introduced into it by designs of this type and form; and, notwithstanding the letter I somewhere read, urging alterations in the *Albion*, it is matter of rejoicing that no money is to be wasted in attempts to improve her, for she is radically bad.

For ten or fifteen years we were going in a wrong direction, and we shall probably take as many to return.

Ten years since Sir George Cockburn was anxious to introduce into our navy vessels of the form from which the idea of the *Niagara* was taken, but was prevented by some of his less discerning

colleagues ; but, now that it has been adopted by the Americans, I am told that it is, or has been, recommended for adoption in our navy as something new and valuable. This form, however, is gradually creeping into our navy, and eventually must, when understood, become general ; Her Majesty's new yacht is, in fact, of that form.

The *Diadem* is a step in the right direction ; but her guns are too high, the full extent of which evil we shall not arrive at a knowledge of till the suggestions offered by Lord Hardwicke in the House are adopted generally—that of “ testing the gunboats by target-practice at sea,” and comparing them with other vessels under similar circumstances of weather.

Generally, it would be sufficient to make a careful series of observations on the turns and angles of roll of ships of different forms, together with the effect produced on them by adding or taking out weights, and, if observed with respect to large and expensive ships, all the more important. I may add, that this information would not be confined in its value to men-of-war, but would be of use, if made available, to all the ship-builders in the country. These observations for the most part might be made at anchor in any tolerably open roadstead, and need not entail much expense, and none certainly as compared with their value.

I am greatly mistaken if such ships as the *Exmouth*, and many others, would not prove to be very inefficient in a seaway, from their rapid and extensive rolling-motions.

I am convinced that it would be established that the efficiency of every man-of-war would be increased by an addition to its present quantity of ballast, and that vessels of the *Vanguard* type would benefit most by such an addition, and should receive a greater proportion than any other type of form, as by it the number and extent of their oscillations would be considerably reduced.

The sailing of the latter class would be impaired if nothing more were done ; but the addition of six inches of false keel would correct this. But, as many may be at a loss to understand how keel could produce this result, I will endeavour to explain.

One effect of keel is to reduce the arcs of oscillation ; but, as a ship rolls *not* round the centre of gravity, as is generally supposed, but round points alternately on one side and the other of that centre,

and the more distant the more deep or extensively she rolls, so she presents a more irregular and more changed form of transverse section, and consequently in that degree offers more resistance to motion in the direction of her keel.

Thus a cylinder, if revolving on its axis, and moving in the direction of that axis, would always and only offer the same-shaped area of resistance; but if the axis were on either side of the centre, increased resistance would result, because this same area, revolving round its new axis would, so to speak, make a larger hole and offer more resistance. Now keel, by reducing these arcs, reduces the resistance, and to that extent contributes to fast sailing, while if the ship be sailing by the wind, or, in any degree a side-wind, by preventing her drift to leeward, in that degree also contributes to fast sailing.

Till we possess the result of many more observations and experiments worthy of the name, naval architecture, to a great extent, must remain sheer empiricism, and the extent to which it is so now, and the great loss which the country sustains in consequence, none can know but those very very few who have really studied the subject—losses which are all the more to be regretted, since they are so unnecessary, but are the result of every sailor, and everyone that pretends to be one, taking for granted that they know all about naval architecture, while it is marvellous the extent to which, and the oracular air with which, fallacies are propounded.

The Government ought to have taken up the subject long since as one certainly not less important than meteorology, in reference to which they are gathering statistics; failing their doing so, private individuals will have to establish a society for promoting naval architecture.

The great American clipper-builder admits that his information was drawn first from lectures which were delivered in your Institution, and thus a new era in naval architecture may be said to have been inaugurated there. It may be that these few thoughts may elicit something further, and help on the formation of a society such as I have alluded to; greater things have had much smaller beginnings. It is time that this great maritime country should lead in questions of maritime science.

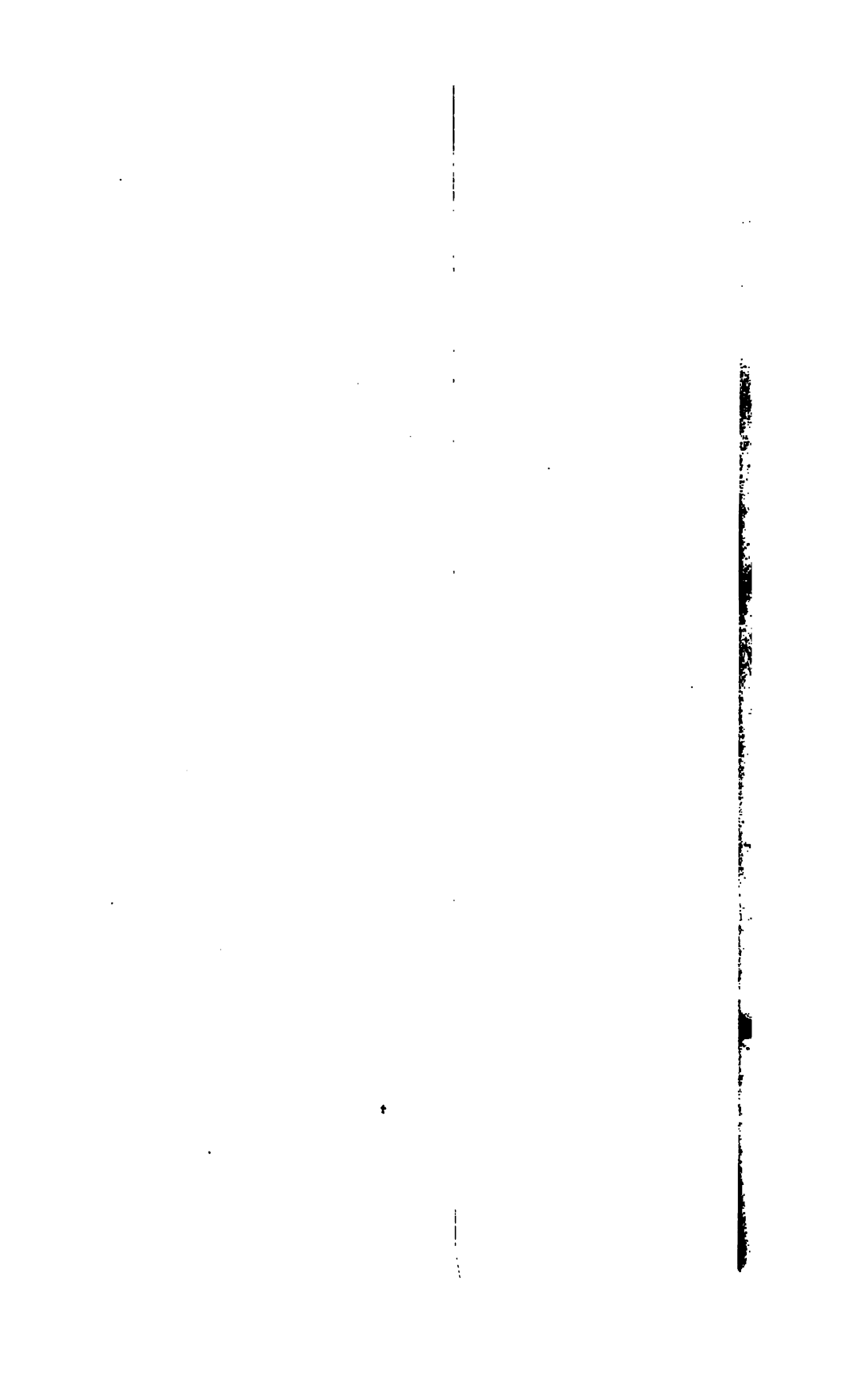


DIAGRAM OF A DISCOVERY WITH RESPECT TO MAGNETISM.

BY CAPTAIN NOLLOTH, R.N.

Captain NOLLOTH, R.N., exhibited and explained the annexed Diagram, showing the deviations of the standard compasses of eleven of H.M. ships when last swung; the amount of east, or west, deviation observed at each compass-direction of the ships' heads being marked on the point of the compass accordingly.

It appears that, by this method of graphical delineation, a convenient means is afforded of comparing various forms of deviation curves, and of considering them in connexion with the circumstances of magnetic influence under which they respectively occur.

It is also suggested that, in practice, vessels may find this mode of marking (effaceably) the compass card more convenient than reference to a table of figures.

No. in Diagram.	Ships' Names.	Guns.	Tons.	H.P.	—
I.	Trident . . .	6	850	450	Paddle steam-vessel (iron —wooden beams)
II.	Ajax . . .	60	1761	450	Screw steamer, guard-ship
III.	Adventure . . .	2	1965	400	Screw steamer, store-ship
IV.	Retribution . . .	28	1641	400	Paddle-wheel steam-frigate
V.	Conqueror . . .	101	3265	800	Screw steam-ship
VI.	Thunder . . .	14	1469	150	Screw floating battery (iron)
VII.	Blenheim . . .	58	1838	450	Screw steamer, guard-ship
VIII.	Pearl . . .	21	1466	400	Screw steam-corvette
IX.	Amethyst . . .	26	923	—	Sailing-vessel
X.	Vulcan . . .	6	350	800	Screw steamer, store-ship (iron)
XI.	Victoria and Albert (brass.)	2	2342	600	Screw steam-yacht

EXAMPLES.

Head by Compass.	Ships.	Deviation.
N.E. by E.	Conqueror . . .	° / 10 50 E.
	Vulcan . . .	0 0
	Trident . . .	19 30 E.
	Blenheim . . .	9 0 E.
W. by N.	Conqueror . . .	5 30 W.
	Vulcan . . .	4 20 E.
	Trident . . .	23 20 W.
	Blenheim . . .	12 40 W.

(The ticked lines in diagram denote east, and the full lines west,
deviation.)

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LECTURES.

June 26th, 1857.

COLONEL THE HONOURABLE JAMES LINDSAY in the Chair.

THE RIFLE—ITS PROBABLE INFLUENCE ON
MODERN WARFARE.

BY LIEUT.-COLONEL DIXON, R.A.

IN offering to the Institution a Lecture upon the subject of the Rifle, I desire to separate my remarks under two headings, viz., what I state as matter of fact, and what as matter of opinion. The latter is open of course to agreement or disagreement on the part of all who have considered the subject, and nothing will in my idea conduce more to correct notions upon what *may* and *may not* be expected from the rifle when extensively employed in modern warfare, than free, open discussion upon every thing connected with it, as an arm *per se*, and when employed by the class of men in whose hands it is placed.

I would suggest the importance of always regarding the *rifle* and the *soldier* as inseparable in discussing the relative value of different

arms, and by so doing we shall avoid forming, possibly, exaggerated notions of what may be anticipated from the infantry soldier in future warfare.

The history of the rifle is comprised in a few words.

The two great features of the arm, as tolerably well understood at present, are—

- 1st. The employment of a cylindro-conoidal projectile ; and
- 2ndly. The grooving or cutting into channels of the interior of the bore of the barrel.

The last circumstance was, in order of chronology, the first done; but for a different object, if we may believe the writers on the subject, to what it is employed for at present.

It is stated generally, that the rifle, or grooved barrel, or (French) carabine, was invented previous to 1498; and the inventor is said to have been a certain *Gaspard Zollner*, of Vienna.

The discovery arose out of the following circumstances.

This arm previous to being grooved had been constructed as an experiment to load at the muzzle (the early form of all fire-arms being breech-loaders), and it was soon found out that the tighter the bullet fitted the better was the practice at the target. The loading, however, with these tight bullets, particularly after the bore had become foul, was anything but easy, and in fact required the assistance of a mallet and strong iron rammer.

Accident pointed out that the loading was easier when the bore was badly cut, or when there existed certain grooves in it, left, no doubt, from the inferiority of the boring-bits then used.

The next discovery appears to have been, that, when these channels were twisted spirally round the bore, greater accuracy was obtained in shooting.

Here, however, matters rested ; the phenomenon existed, was recognised, and wondered at. The learned were not, however, there to explain it.

Every description of twist and number of grooves were tried, according to the individual tastes of the manufacturer, but nothing of any moment was done.

Some assert that the idea of lengthened elliptical bullets was enunciated as far back as 1729, and that good results followed their

employment. An isolated experiment or two may have been tried, but it is doubtful whether such really did take place.

The important stage next arrived at, was the scientific explanation of the true value of the spiral groove cut in the bore. The honour of this entirely belongs to our own countryman Benjamin Robins.

In his *Principles of Gunnery, &c.*, there is a complete and satisfactory explanation of the action of the grooves in determining the flight of the bullet. This was, however, connected necessarily with the doctrine of the resistance of the air being very sensible as a powerful agent acting in a direction contrary to that of the ball's flight, and also as a deflecting agent, disturbing its accuracy under the varying circumstances of the ball turning over in its flight, or revolving upon some axis, generally, if not always, not coincident with the line of projection.

The numerous experiments which this great philosopher originated and successfully carried out, at once determined the importance of the grooves in the interior of the bore, and the effect which they caused upon the bullet. I cannot do better than direct attention to his tract on rifled arms, written considerably more than 100 years ago.

Robins seems also to have considered the question of a lengthened projectile for the rifle, and actually mentions the advantage which might be derived from an egg-shaped bullet. The idea was unfortunately not pursued; and at the end of the last century we find the first English army rifle adopted for the Rifle Brigade, with a spherical bullet. This arm had a barrel 2ft. 6in. in length, with a quarter-turn for the grooves. The calibre was what is designated as a 20-bore. The arm was rifled with seven grooves, and generally went by the name of "Baker's Rifle."

In the early part of the present century there was also introduced a rifled arm for cavalry. The barrel was 20 inches in length,—the calibre a 20-bore, and rifled with seven grooves of the same pitch as the last. Only two cavalry regiments were armed with these rifled carbines, viz., the 10th and 7th Light Cavalry; but they were soon discontinued, from being considered as unfit for cavalry service.

Some slight alterations in the sword-bayonet for the army rifle took place about 1827 ; but no radical change in the system occurred until 1836, when the Brunswick rifle was introduced.

The points to be noticed in this arm are,

Firstly. The adoption of two deep grooves, with a rapid pitch ; and,

Secondly. The employment of a belted bullet, to take the grooves, and thus prevent "stripping,"—a circumstance which would otherwise have happened with a rapid pitch of groove.

This was an advance in the right direction, and a positive rotation was thus obtained with certainty. The arm was much improved in shooting, although the loading was not as easy as was required, and a great disadvantage existed in the bullet and cartridge containing the powder being separate in the soldier's pouch.

With respect to the shooting of the early rifles, it was considered good shooting to place twelve consecutive shots within a radius of 12 inches at 150 yards, within 18 inches at 200 yards, and at 300 yards to keep them regularly on a six-foot target.

To complete the account of the rifles with spherical bullets, which continued in the English service down to 1851, it is only necessary to state, that subsequent to the French experiments with the conoidal bullet, and the great results obtained over the spherical form, it was proposed to adapt a conical bullet to the Brunswick rifle. This was done as an experiment, and succeeded very well ; but at the same time the new arm called the Minié pattern, 1851, was being experimented with, and, the shooting exhibiting greater accuracy with this latter arm, nothing further was done with the Brunswick rifle and conoidal bullet.

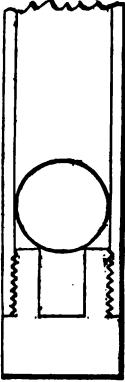
FRANCE.

Chronology of improvements in Projectiles which led to the Cylindro-conoidal form.

The difficulty of loading with the spherical bullet, necessarily fitting tight in order to ensure tolerable accuracy, had led the French, during the Wars of the Revolution, to abandon the arm.

Still the attention of numerous military officers was directed to the subject.

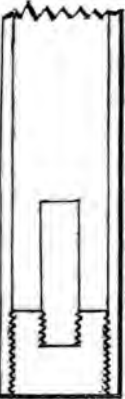
At last, in 1827, M. Delvigne proposed a method of loading which should be perfectly easy and simple; in short, as much so as that of the smooth-bore arm.



In order to obtain the expansion, however, he proposed the introduction of a chamber in the bore having a small opening to receive the charge, and furnishing, besides, an annular surface to receive the bullet and allow of its being struck a smart blow with the rammer, and so expanding into the grooves. This bullet was still spherical.

After numerous experiments, and the addition of a wooden sabot to the bullet, and a greased wad, the arm was introduced into the French service, and employed by their troops in Africa.

Next came the invention of the Tige, by Col. Thouvenin, 1842.



The *principle* was similar, though the method of giving the expansion to the bullet different.

Assisted by Capt. Tamisier and Minié, numerous experiments were made with carabines à tige and spherical bullets.

The next great discovery, and the one which at once caused the arm to take an immense stride in advance, was the cylindro-ogival ball.

It is said that M. Delvigne had experimented with the cylindro-conical bullet in presence of Capt. Minié, and that great results had occasionally been obtained. The proper relation, however, which should exist between the number of grooves, their pitch, depth, &c., and their evident dependence upon the weight of projectile, charge of powder, calibre, &c., delayed the introduction of these bullets for a time, until considerable experiments had settled within certain limits the above points.

The facility of loading with the tige, and the excellent results presented by the practice with this bullet, determined the introduction of the carabine à tige and cylindro-conoidal bullet with solid

base in 1846, and the arming with it of the Chasseurs and Zouaves of the African army.

Some years after these last experiments Capt. Minié proposed the adoption of a bullet which should receive its expansion through the influence of the charge on exploding.

This bullet has rather a flatter head, and received an iron cup in the hollow of the base of the bullet. The gas was supposed to drive this cup into the hollow and force the walls of the cavity outwards, thus making them enter into the grooves.

This idea, assisted by some other unrecognised cause, was found on experiment to succeed very well; but the complication which it introduced, viz. that of making the bullet consist of two parts, operated against its definitive introduction. It however gave rise to numerous endeavours to employ the principle of self-expansion, but without the cup, or anything attached to the bullet.

In 1850 the Fusil rayé, with balle à culot, was put into the hands of a certain number of French regiments of the line, and since then the French Imperial Guard have been armed with the old musket rifled, and a bullet without cup, on the self-expansion principle. At present it is understood that the French government are rifling all their smooth-bore arms, and the Russians are doing the same.

The English Minié, pattern 1851, was the result of the experiments conducted in France; and, in fact, was to a considerable extent a copy of a foreign arm. The calibre of this arm was .702; the bullet was of a cylindro-conoidal form, and was furnished with an iron cup. The total weight of arm was 10½ lbs.

This arm being still considered too heavy, and the ammunition weighing too much to allow of sixty rounds being carried by the soldier conveniently, the late Lord Hardinge ordered a committee to assemble in 1852 for the purpose of going still further into the question of rifled arms.

This Committee commenced their labours by enunciating what they considered, as military men, should be the object kept in view, viz. :—

“ To ascertain the best description of fire-arm for military service, and not merely the best rifle for firing at a mark or for sporting purposes.”

All line soldiers requiring to be armed with a rifle of a lighter description than the pattern of 1851, it was, of course, a *sine quâ non* that the arm should not be more difficult to load than the old smooth-bore. Infantry in line must necessarily fire quickly when once deployed and in close action. The necessity, therefore, for an easy-loading weapon, which should be sufficiently accurate at those distances at which infantry deliver their fire, was *absolute*. With this point no doubt kept prominently forward, the idea was held that as large a bore as possible, consistent with carrying a large quantity of ammunition by the soldier, should be adopted, so that a crushing, accurate, and close fire, as well as a rapid one, might be ensured.

The question was a difficult one at that time to settle so as to satisfy the wishes of all parties, but it was no doubt safe to consider the wants of the line infantry soldier first.

This being done, it was competent for the Committee to recommend either the same arm for riflemen proper, or for such corps as might be instructed to fire at long ranges, or else (if, in view of greater simplicity on every hand, they thought it advisable) to recommend the same arm sighted for longer distances for the special rifle corps. This latter was done.

It will be here seen that the Committee balanced the advantages which on the one hand would possibly accrue from the introduction of a more accurate shooting-gun for the special corps, with, on the other hand, the disadvantages of having two patterns of arms. I do not here allude to mere length of barrel, or substitution of sword bayonet for common bayonet, but the alteration of calibre, form of rifling, shape of bullet, &c.

It will be easily comprehended that a military arm has *many conditions* to fulfil. The mere consideration of accuracy beyond what is required for the particular service of the arm might lead to considerable difficulties in other directions, such as hard-loading, quick-fouling, difficulties in manufacture of arm and ammunition, difficulty of repair or of maintenance.

For example, although small calibres with rapid twist and wing-projectiles give greater accuracy, yet fouling takes place sooner, loading becomes more difficult, and finally accuracy is lost. The

French have tried numerous experiments with small calibres and long bullets, the latter increased even to six and seven diameters in length.

After extended experiments, the Committee decided upon recommending the arm which goes now by the name of the Enfield rifle, or pattern 1853 rifle musket.

The points to be noted in this arm are—

1. That the grooves are limited to three.
2. No greater spiral allowed than is necessary to keep the bullets in the grooves.
3. The most perfect facility of loading.
4. The expansion into the grooves, so ensuring the necessary rotation, is effected at the instant of the inflammation of the charge of powder, in consequence of the upsetting of the lead, assisted possibly by the wood plug which closes the orifice at the base of the bullet, but which no doubt prevents any collapsing of the sides of the bullet when leaving the barrel, a circumstance which would otherwise happen, and thus disfigure the shape, and act prejudicially in other respects. The advantages on the side of the plug are, besides the above, the less frequent fouling of the barrel; in fact the grooves are cleaned out and lubricated after every shot.
5. The calibre of the arm .577 allowing of a bullet of sufficient weight to do all that is required of it, but not so heavy as to prevent 60 rounds being carried well by the soldier.
6. The shooting of this arm as a line infantry weapon is most superior, and when carefully made throughout corresponds to every requirement of the best-instructed infantry soldier.
7. At long ranges, that is to say, up to 1,000 yards, though only sighted to 900, the arm makes very good practice, and thus becomes qualified for a rifle-arm for special corps.

If to all this is added that the arm was one easy to be made, and that the ammunition was of a form capable of being turned out in large quantities very rapidly, it would appear that the Committee had not been far out in their judgment or sagacity in the selection of such a weapon.

The above points, many of which concern the manufacture of the arm, were of vital importance at a period when it was of

the utmost consequence to obtain a rapid supply, for had any complexity, either in the form of barrel or bullet, interfered much with the manufacture, it would have been almost impossible to have armed all our troops with it during the late war.

I have now sketched so far the history of the rifle down to the present moment, and in so doing it is only necessary to bear in mind—first, that the principle upon which correct rifle practice depends is the insuring a rapid rotatory motion of the longer axis of the cylindro-conoidal bullet in the direction of the plane of fire—thus equalising the resistances all round the pole of its circular motion; and, secondly, that the system adopted to ensure this result was one including the greatest facility in loading, and thus rendering the arm well-adapted for the line infantry soldier.

Whether greater accuracy may not yet be obtained by some alteration in the form of rifling, or shape of bullet, or structure of interior of the barrel, and without interfering with ease of loading, and all the other advantages named above, is not for me to determine. Everything, to a certain limit, is possible; and it is not to be supposed that the best arm, combining every advantage, has yet been constructed. One thing must, however, be considered as reducing the question down to rather narrower limits than at first sight may appear when the rifle is viewed abstractedly. I allude to the class of men into whose hands the arm is placed.

There is no difficulty, comparatively speaking, in the instruction of an individual; but here we deal with the mass, and have to contemplate the intelligence of the body, and to ensure that our standard of perfection or of instruction is not of a nature too high to be hoped for from the many.

Disturbing influences, error of judgment, physical defects, and other causes, all enter largely into the question of the real value to be anticipated from pursuing the question of greater perfection of fire-arm while the soldier remains stationary at a certain point.

Take for example the difficult task of instructing in judging distances even upon easy ground, and the constant practice required even to obtain a tolerably good judgment on this point. Then, transfer yourself, in imagination, to a country of an undulating nature, broken and interspersed with wood and water—a man not

only looking out to shoot at, but to be shot at, hurrying as well as his adversary from one position to another, and excited by every circumstance which in battle may be considered to operate so powerfully to disturb a man's judgment or his aim.

Why, in this mere matter of judging distances, a man who can judge better than another will, with a weapon much inferior to the other, probably do more execution.

In point of fact, the difference in degree of accuracy at ordinary distances of two rifled arms, bears no proportion whatever to the difference which exists in the capability of appreciating distances between any two individuals.

Again, it must be borne in mind that the larger the body which has to be instructed the more difficult becomes the task of raising it up to a certain standard, and generally speaking, the lower, comparatively speaking, must that standard be.

In the instruction of a rifle corps *per se*, a high standard could, no doubt, be aimed at, and possibly attained.

No rifleman should fire quickly; every one of his shots should tell; and he may more frequently be called upon to fire against skirmishers, or artillery and cavalry in extended order, and therefore he should be calm and deliberate; it is not so with the line infantry soldier, whose instruction should be based upon this fact, that his function is to fire quickly, and at, comparatively speaking, short distances.

It is far from my wish or inclination to decry the advantage of the greatest possible amount of accuracy in an arm which it can be made to possess. All I desire to enunciate here is, that there are many important conditions for a fire-arm to fulfil besides great accuracy, and that individual and other errors may entirely nullify the advantages to be anticipated from such an arm when placed in the hands of a line soldier.

Here, as in every other thing, the balance of advantages against disadvantages must be struck, and a mean term found which shall give the best results under every condition.

As a corollary to what has just been said, it would appear that if we regard infantry as still likely to be employed in two different capacities, viz., as the soldier of the line acting in mass, and as the

rifleman proper acting as *skirmisher*, or real light infantry man, two different degrees of instruction are demanded—

Firstly. That of the infantry soldier, for the proper employment of his weapon at those distances at which he is likely to use it: and

Secondly. That of the rifleman, who, from being called upon to act independently and in an individual capacity, and at distances greater than those of the line soldier, and perpetually varying, should have as far as possible a complete knowledge of his arm, and above all a facility to be obtained from long and continued practice of judging distances.

For the larger body who have to be instructed, a system combining the utmost simplicity and efficiency with the least demand upon the intelligence or memory of the soldier, seems the most likely to succeed.

For example, and in order to make my meaning clear, I suppose that the fire of infantry in line commences at 400 yards, which may be considered as the greatest distance at which file-firing should be allowed to take place.

It would simplify the operation of the soldier very much if a single sight could be formed, to be employed at all distances from 400 to 100 yards, without giving him the trouble of thinking about altering it for varying ranges. Again, it would be an additional boon if it could be found that this fixed sight, combined with aiming always at one and the same part of a man's body, would ensure his being struck at any distance between the 400 and 100 yards.

The only instruction, as far as distances were concerned, would then be restricted to the single one of 400 yards; and, as far as aiming would have to be taught, that of firing at the point determined upon.

Now this I believe to be quite feasible, and in fact, from my own experiments, I have ascertained that, by aiming at a determinate point, low down on a man's body, I could strike him by using one sight at any distance between 400 and 100 yards; of course the part struck being higher at the closer distance, but still some part of the body was struck.

I mention this, as no doubt it may gain the attention of those

who have the duty of instructors of musketry, and who have, before this, found out how difficult, nay, almost impossible, it is to teach men to judge distances with anything like sufficient accuracy ; and, as I said before, that as the errors on this head are much greater than the relative accuracy of different arms, and are such which every one must recognise, it becomes a most important question, in order to prevent the useless expenditure of costly ammunition, to devise some method by which the soldier shall be relieved, to a great extent, of the call upon his judgment in this matter of distances. If so difficult to attain in peace time, how can we expect the efficient and correct exercise of this faculty in the field ?

The instruction of special corps of riflemen, and also of the flank company of regiments of the line, might be more extended, and in fact every care bestowed upon these *sharpshooters*.

The flank companies of a regiment might be filled with the best marksmen of the regiment, and a proper spirit of emulation cultivated amongst the men to induce them to strive after such a distinction as promotion to a flank company.

And yet one more idea would I propound here, and one quite as necessary to be considered as the putting of the best arm into the soldier's hands, I allude to the preservation or maintenance of the arms.

Without the utmost caution, vigilance, and watchfulness on the part of all the officers and non-commissioned officers of a regiment, the arm may be soon rendered unfit to be considered as a good shooting one, by the inconsiderate and rough usage it meets with in the hands of the soldier. A rifle is a delicately constituted weapon, and, like a horse, soon shows the effect of *hard work*.

This is a point of great importance, in which the moderns may well learn a lesson from the ancients. Who more careful to keep his arms in good condition than the Roman legionary soldier ? Where do we find in modern armies such attention paid to this essential point as in the code of the old Roman armies ? With us instruction in the use of the arm should be also accompanied by the most stringent regulations, enforcing the utmost care to be taken of it, and prompt and severe punishment should follow any carelessness on this head.

As a manufacturer I have taken the liberty of enlarging upon these points. I wish to see the best arm in the hands of our men that can be obtained under the conditions required, and I wish to see that arm, at the end of ten years, shooting as well as when it was first issued.

Comparative Table of Various Arms.

WEIGHT OF DIFFERENT ARMS AND THEIR AMMUNITION.

	lbs.	oz.
1. Percussion Smooth Bore ('753), 1842, and bayonet .	11	3
Ammunition, 60 rounds and 75 caps	6	10
Now obsolete.	17	13
2. Ditto, ditto rifled ('753) about	11	0
Ammunition, 60 rounds	8	9
	19	9
Bullet, with cup, 848 grs.; diam. '745 to '746; charge, 3 drs.		
Used by the Royal Marines.		
3. Ditto, cut down for Naval Service ('753)	10	6
Ammunition, as No. 2	8	9
	18	15
4. Minié, '702, Rifled Musket Pattern, 1851	10	8½
Ammunition, 60 rounds	7	0
	17	8½
Bullet, with cup, 696 grs.; diam. '690 to '691; charge, 2½ drs.		
Superseded by the 1853 pattern arm.		
5. Enfield Rifle Musket, '577, pattern 1853	9	6
Ammunition, 60 rounds	5	8
	14	14
Bullet, 530 grs.; diam. '568; charge, 2½ drs.		

	lbs.	oz.
Short Rifle, pattern 1855, sword bayonet	9	11½
Ammunition, 60 rounds	5	8
	15	3¼

Bullet as for Enfield rifle.

For Rifle Regiments, Serjeants of Infantry, and Marine Artillery.

Short Rifle for Serjeants of Infantry and Royal Navy, E.I.C. as above; only ordinary bayonet and brass mountings.

Artillery Carbine and Sword Bayonet, .577 bore	8	3¼
20 rounds	1	13
	10	0¼

Charge, 2 drs.

Sapper's Carbine, oval bore	9	2
Ammunition as for Enfield.		

Calibre .577 minor axis	} muzzle.	Calibre .580 minor	} breech.
.589 major ' „		.592 major	

Increasing spiral from breech to muzzle one-fourth of revolution.

Brunswick Rifle, 1836, weight of, with sword bayonet	11	15
Ammunition, 60 rounds	7	6
	19	5

Having now discussed the first portion of the subject, I come to that part which touches upon the *future* of the arm, in relation to its probable influence on modern warfare.

This subject is one which least of all will bear to be treated dogmatically. I come to it with considerable diffidence, and own that in the matter of a mere opinion I am not more likely to form a correct, or as correct a one as many an officer who has also carefully studied the art of war. At the same time I do not shrink from drawing out discussion upon this interesting point, and more particularly as it will lead one off the more abstract question of rifle practice, &c., into the larger one of tactics generally, including, of course, in that term manœuvres of infantry.

I have not considered it necessary to introduce strategy as likely

to be directly affected by the introduction of the rifle, except in so far as a better armed and better instructed army, and one with its commissariat and whole interior economy better managed, than those of its adversary, may give greater confidence to the general commanding, in arranging the lines of operations, objective points, and in short the whole plan of a campaign.

Still, the general principles of strategy must remain the same; they depend upon circumstances and causes which are fixed and immovable, and such as the military topographer will at once recognise.

These causes will ever govern the lines of operations, the retreats of armies, and the defence of certain points.

For example, in examining the map of Europe, or what is better that of France, and that portion of Germany which is included in the campaign of 1796, by the Archduke Charles (or that portion of France entered by the allies under Schwarzenberg by Basle, opposite *Belfort*), or the southern frontier, and its roads concentrating on that town which is the centre of defence for that region, viz., Toulouse; or the northern frontier, extending from Dunkirk to Lauterbourg on the Rhine, and defended by five or six lines of fortresses culminating in Paris; all these will convince the military reader that the operations of armies will continue to be governed by the same rules which have raised this branch of the art of war into a science.

As a digression, I cannot do better than impress upon every young officer the value in every sense of studying military topography. The advantages to be gained by any one from accustoming himself to study not only the relations of sieges and battles, but the causes which have operated (even from the times of antiquity) in determining more than once battles to be fought in certain localities, operations to be conducted on certain lines, and the occupation of certain points to be always attended with favourable results, will more than repay the labour bestowed upon the subject, besides giving him a fund of interesting information, to be made use of as a tourist or scientific traveller.

I cannot afford time to enumerate localities, or enter into details here, but I will mention a valuable little work on military topography,

that by M. Lavallée of the French service, and a portion of it, viz. that relating to the Military Topography of Continental Europe, translated by Col. Jackson.

The study of military topography leads to the study of fortified places, and of fortifications in general. The great extension of the principle of entrenched camps, with their peculiar sites, is of great interest to the military man. I recommend, as particularly worthy of note, the fortifications of Antwerp (improved of late), Diest, Rastadt in Baden, and Ulm, &c., all of recent date, and each illustrating some particular ideas, and fulfilling particular objects.

All these places are likewise interesting, as furnishing subjects of thought for those who contemplate the value of the rifleman in the siege and defence of places.

Questions as to the proper length of lines of defence—the value of the caponnière, or casemated system of Montalembert, illustrated by so many Prussian models, the examples of *active* defences of places, with the last and most splendid of all, that of Sevastopol, may all contribute towards the solution of the question,—“What influence will the extended employment of riflemen exert in sieges?”

What, however, are to be the tactics of modern infantry and the relation of the other arms to them?

The infantry is the most perfect element of an army, and has always been recognised as such.

The offensive and defensive characters have always pertained to it, and to it alone.

Artillery possesses only the defensive character, and cavalry the offensive; consequently, it has always required a proper union of horse artillery and cavalry to give the single perfect element required in a military body. Either of these two arms becomes the complement to the other.

It is therefore to be expected that infantry should seek to perfect themselves in their arms and general mobility; and it is no disgrace in the other two arms to have to follow, and keep up, if possible, with its progress in those particulars. It would be unfortunate if anything should tend to disturb the proper relationship that ought to exist between the three arms.

Formerly, when the Swiss infantry or the Spanish infantry had a preponderating force in the decision of battles, the true action of cavalry was lost sight of. Vain attempts were made to pierce these solid masses of infantry armed with long pikes ; the results of battles were not so decisive as they ought to have been, and the true principles of the art of war were lost sight of.

The introduction of artillery into the field tended to re-establish the balance between the three arms.

The unwieldy masses of infantry presented most favourable targets for the new fire-arms ; and, when once broken, the action of cavalry was properly employed in completing their defeat, and preventing their again rallying. From this cause may be traced the gradual giving up of the deep column formation and the extended occupation of ground by thin long lines.

The deep formation was not given up at once, in consequence of the want of skill in manœuvring of the three arms ; and it was only finally effected when the infantry had been armed with a fire-arm possessing an offensive, as well as a defensive, character ; or, when the infantry, armed with a musket and bayonet, had all the force of the old infantry armed with the pike and musket.

To remedy the weakness inherent in so extended a disposition, science came in to assist in the selection of ground, in the determination of the method of attack, and the points of attack ; and gradually the art of war emerged from the obscurity under which it laboured in the middle ages, and shows itself now in the proper and beautiful proportions of an art, or even of a science.

I have, in a former part of my lecture, assumed that infantry will still be composed of the line-infantry soldier proper, and of the special corps named riflemen.

I do not think that under any circumstances battles could be fought or gained by skirmishers or infantry acting in extended order. The impossibility of controlling or directing such irregulars would nullify all advantage likely to be obtained from each man being a good marksman. Independent of which, such a system would fall to pieces in the end from its own inherent defects. An army would cease to act as a whole, and operations would be restricted to a multiplicity of small and insignificant attacks at isolated points.

Well, then, we come to the present system, viz., the action of infantry in a mass, and that of skirmishers, which I believe cannot be disturbed by the introduction of the rifle.

The true force of infantry in action consists, first, in its fire ; and, secondly, in the charge.

These two cannot be separated. No good or decisive results can be anticipated on land or at sea by playing at "long bowls." That infantry or that vessel of war which shrinks not from opening fire against an adversary at ranges of about 400 yards and under, and delivers its fire with the greatest efficiency, coolness, and determination, will come off best. The distance is then favourable to close; and if rapid and decisive results are to be aimed at in future wars, they will only be attained by using the superior arm which our soldiers now possess, at distances not materially varying from those at which they formerly attempted with inefficient means to do their duty.

Modifications in point of celerity of movement and simplicity in bringing up men under fire, or to take up certain positions, will materially influence the results. It is possibly now the time for endeavouring to remodel the old Prussian system of manœuvres.

What did the Duke of Wellington mean when he said, after witnessing a review of the Prussian army, that he thought, with his little army, he could manœuvre round them before they had made a change of position? Was he not alive to the necessity of rapid movements, or rather movements which become so from being simple and easy of execution?

Much has to be done, I believe, in this respect, without at the same time attempting to move bodies of men at the rapid pace advocated by some French officers of the present day. The direction which every ones energies should take is that of simplifying the present manœuvres of the battalion to the utmost, and the quick and true formation of the line which naturally is the final object of every change of position.

With respect to squares, it is a delicate matter to express an opinion upon. I would, however, point to the famous battle of Minden, in the Seven Years War, where the finest and best appointed cavalry in Europe was utterly routed by the English Con-

tingent acting in line. In fact, the English regiments advanced in line against the French cavalry, who were posted in front of them, and although charged repeatedly and attacked by artillery on the flanks of the cavalry, this infantry received and defeated the cavalry, in line, and no doubt in a much more signal manner than if they had been formed in square. With the rifle, at present, I should prefer meeting any cavalry in a line formation to that of a square, the extent of fire developed would do all the necessary work, and I consider that no cavalry could face such a fire. The reason why cavalry have not hitherto done much against squares, is from the difficulty of bringing a cavalry soldier up to the square, and not from the real strength which such a formation gives the infantry.

These are, however, points on which many different opinions will be held; but the action of the rifle will, I think, determine many waverers.

With respect to the action of the new arm as determining a corresponding improvement in the arms of both artillery and cavalry, it must be at once acknowledged that the action of skirmishers firing at 800 or 900 yards, and possibly with explosive shells, against masses of artillery or cavalry, would be very inconvenient and uncomfortable to these arms.

The improvement in artillery will, it is believed, to a considerable extent, balance affairs as far as this arm is concerned, and the artillery officer must, by tactical skill in the position of his guns, prevent their being made the object of an attack by skirmishers. Artillery not being intended to act, except against *masses*, there is no reason for supposing that as long as the preliminary action of skirmishers against skirmishers is going on, the guns would be posted in such a way as to attract or draw upon themselves this fire.

The artillery officer will no doubt be more on the alert than ever, to avoid posting his guns too soon or in too exposed a situation, but when once in action the great effects produced by the late improvements in shell and spherical case shot, together with the great facility an *artilleryman* has of *ascertaining his distances*, from being able to *watch and witness the effects of his shot*, will most certainly give to this arm a great preponderance in determining future battles.

The true action of cavalry, as operating against infantry, will be restricted, doubtless, to its legitimate object. We shall not see again cavalry thrown away at an early period of action, while infantry are still intact. The arm must be still more than ever retained as a special reserve for determining the rout of infantry when in disorder from the action of artillery or other causes, and for reaping all the fruits of a victory by pursuing and destroying a broken army.

The action of cavalry then would seem to be both simple and proper, both as regards its real functions, and in view of the impossibility of its standing before compact infantry armed with the rifle. The special employment of any corps of cavalry in the capacity of the old dragoons, viz., by arming them with rifled arms, and employing them mostly to use their arms on foot, and in skirmishing order, is a subject which I do not enter into. Artillery might no doubt receive very efficient protection from such a force, but it is probable that a still better protection for the flanks of artillery, always very weak points, would be some special infantry corps whose duty would be to keep off skirmishers from approaching too closely.

In the attack and defence of places I look for important changes as likely to arise from the employment of the rifle. Where an army is numerous in a besieged place, and can afford, in consequence, to act, as Carnôt suggested, in an *active sense*, then will sieges be far different things to what they have hitherto been.

The defence of the enceinte will not require to be entrusted to works as closely allied to the body of the place as at present. The length of lines of defence, at present restricted to the powers of the old musket, will be taken into consideration in the projection of any new fortifications, and possibly greater alterations in this respect will result than I have anticipated in the art of tactically disposing of or engaging troops in the open field.

I must fairly own that many different opinions to those I have stated are held by foreign military writers upon the subject of the probable alteration in the system of infantry tactics as necessitated by the introduction extensively of the rifle.

The question by them is regarded in two lights, according to the

different views held: first, as a complete transformation of the infantry soldier into a rifleman proper, and the very great or almost exclusive action of skirmishers in future warfare; or by others the creation of the flank company of all regiments into riflemen, while the centre company are armed either with the smooth bore or rifle sighted for short distances, and the drill so altered as to allow of movements being rendered much more simple, and their execution quicker, by the adoption of the *pas gymnastique*.

The former is advocated in a work upon small arms, written by a Belgian officer.* He says, at page 334:

“Rifled arms giving the advantage of accuracy at very long ranges, the fire of infantry ought to become, in a greater degree than ever, a fire of skirmishers, and, their fire assuming much more importance than formerly, the extent of front presented by armies must necessarily be much increased.”

He intends, I imagine, not that the infantry soldier should be allowed to skirmish after the manner of the present light infantry or rifleman, but that greater space than that occupied at present by men in line should be allowed, in order to give greater independence to the individual soldier. How this is to consist with the solidity so necessary for the masses of infantry to have, when required suddenly to charge, or to concentrate their fire upon masses of cavalry, or the enemy's troops assaulting a position, I am at a loss to say. The difficulty in restraining men from uselessly firing away ammunition at long distances, either on the supposition that they are doing good or from the mere force of example, would render the above system a hazardous one to adopt against an enterprising army looking out to close at a convenient opportunity.

The writer continues as follows:

“The effect of the new arm, and its great range giving greater confidence to the soldier, will allow of his doing more execution with it than with the old musket. At great distances he will adjust his sights instead of firing at random: close to the enemy he will fire with more *sangfroid* than formerly, since he will feel confidence in his arm.

* Captain Gillion, Belgian Artillery, 1856.

"It may be added also that the very occupation of thinking of and adjusting the sights for different ranges will take from him all thought of danger, and he will find himself in as favourable a position as the artilleryman, whose coolness and *sangfroid* are proverbial. . . .

"Without doubt it may happen, sometimes, that such things as the smoke on the field of battle, dust, the necessary movements, or the moral situation of the soldier, will nullify the fruits of all special instruction, and will render illusory all the advantages from the superiority in the arm," &c. &c.

The writer, however, thinks that these latter circumstances are only exceptional, and that in all others, the soldier taking the necessary time required to make the best use of his arm, there will still be a very marked superiority over the old arm. This latter statement I entirely agree with; but the means proposed for obtaining the results are not such as I can see to be at all in accordance with the circumstances of any battle-field.

I cannot bring myself to believe or comprehend how it is possible to consider every line infantry soldier a marksman, and one who is to be allowed to be constantly altering and adjusting his sight. Battles have never yet been won through the independent action of the individual soldier. The action of the mass operating as a mass at the decisive and critical moment will still, I think, be required to produce the greatest results.

In the Belgian service a wiser regulation exists on this head than is advocated by the writer of the work from which my quotations have been made. For example—the infantry soldier, practically, employs only three sights for distances as far as 480 mètres.

The first is used from 0 to 300, by aiming at different parts of the body.

2nd. From 300 to 412.

3rd. From 412 to 480.

The *carabine à tige*, Belgian, is sighted to 900 mètres.

Only two sights are used up to 500 paces, or 375 m., and then by special sights for each additional distance up to 900.

Here there is an acknowledgment at once of the necessity of some simplicity in arranging the sights, although the soldier's

memory is still burdened with the recollection of various points to be aimed at.

I have before attempted to show that greater simplicity than even this is desirable, if not imperatively called for.

A French general-officer—Gen. de Lourmel—is the advocate of the second proposition ; and as he went much into detail upon the subject, and was subjected to severe criticism at the time of his pamphlet appearing, I will enter a little into the opinions there propounded.

The general first of all praises very much the light-infantry or riflemen of the French army, called the Chasseurs-à-pied, and considers that the success which has attended their formation must lead to considerable modifications in the infantry of the line.

The alterations, then, in the instruction of line infantry are to be based upon that of the Chasseurs, and every attempt made to introduce very rapid movements in all changes of position or deployments, thus enabling them to follow artillery or even cavalry at a moderately quick pace, but retaining sufficient solidity to attack in line.

Some experiments of this nature were conducted by the 51st Regiment, in presence of the emperor, at Paris, the movements being executed by the three battalions at the different rates proposed, and it is said that the men did not show any symptoms of distress.

Undoubtedly, the system at first sight offers much which appears of great value, and no doubt, if practicable, would give immense advantages to an infantry thus handled.

There are, however, two points which must be considered. The value of infantry consists as much or to a greater extent in the accurate and rapid fire it can deliver than in rapidity of movement.

The disturbance to the whole physical system which must result from very rapid movements, when carrying a heavy load, is adverse to accurate shooting, and is altogether unfavourable to the proper employment of a rifle.

Again, the actual experience which the French have had in their Chasseurs, in respect of the injurious tendency which their peculiar

drill has upon the health of the men, is sufficient to show that with ordinary line infantry, where men are not selected with such care as for the Chasseurs, the rapidity of movement advocated by the general would drive half the officers and men out of the regiment.*

It is well known that the ranks of the Chasseurs have to be constantly weeded of those officers and men whose physical abilities are unequal, after a certain time, to the fatigues of this artificial system. In short, it would appear by all accounts, to lead to a wasteful expenditure of human energy.

Generally speaking, where the necessity for a sudden exercise of physical force is required for a short period, the demand upon the physical frame and constitution of the soldier trained in the ordinary way may be safely made, and has always been responded to. It is only between very limited periods of any man's life that a constant course of violent exercise may be considered as conducive to health and strength. After that period, the energies must be husbanded, in order that on a sudden demand for them they may be forthcoming.

Another and very material disadvantage in very rapid movements is the impossibility of preserving the cartridge from being injured in the soldier's pouch. To give a facility in loading, the cartridge has been made of a certain texture and strength; but this is not sufficient to bear rough usage or shaking about in a cartouch-box.

I would here call attention to the medical opinion of a distinguished French practitioner, Dr. Champouillon, upon the subject of rapidity of movement when long continued, and its influence on the human frame:—

“The running pace is the severest trial to which a soldier can be submitted, and can only be borne by men of short stature and square broad frame. To submit men of weak physical formation to such a pace, as a rule, causes frightful ravages.

“It would be, therefore, on medical grounds, a deplorable circum-

* Pas accéléré—quick step—110 in a minute. Engl. 108 in a minute=3·07 miles an hour.

Pas ordinaire—ordinary pace—76 in a minute.

Pas gymnastique—the pace of *running*.

stance to apply the *pas gymnastique*, or running pace, generally to the line infantry soldier.

“More than once the medical officers of regiments of infantry, and even those of the *Chasseurs-à-pied*, notwithstanding the special selection of the men for these regiments, have felt it necessary to report to the General Medical Board, in the way of special reports, the serious evils resulting to the soldier from the employment of this trying pace, whether in their *manceuvres* or on fatigue duty.

“Some regiments having, in imitation of the *Chasseurs*, established the *pas gymnastique* for the performance of their fatigue duties, the serious illnesses which were brought on in consequence caused an order to be issued stopping the practice.”

I have now completed in an imperfect manner the task I assigned to myself. I have touched upon the history, the theory, the employment, and the probable future of the arm, in its relation to modern tactics.

I think that I have reason on my side in insisting strongly upon the necessity for the utmost simplicity, combined with efficiency, in the instruction of the ordinary soldier, and of the value to be obtained from the more extended instruction of the special corps. I have shown where the difficulty in this instruction lies; and, that in foreign armies, an attempt to get too much out of the ordinary soldier, or even from the special corps, may end in failure. The mark may be overshot as well as not reached.

In our own service we have an excellent school of instruction at Hythe, and the circulation of officers of every regiment in the service through this school will prove most valuable as a means of instructing them in the powers of the new arm, and what it can do when under favourable circumstances. The ultimate point to which the line infantry soldier is to be instructed is, of course, not for me to lay down.

I would merely throw out as a subject for thought and consideration the various remarks I have made in this paper. I hold them only as matters of opinion. I may have underrated the mental capacities of the average line soldier; but, if so, I shall most willingly confess my error if it can be satisfactorily brought home to me.

As a mere brochure upon a very interesting topic for all military men, I offer it to the military public, and have to thank those present for their kindness in listening to one who had, from his numerous duties, hardly the necessary time to arrange his materials in a proper form for a public lecture.

July 3rd, 1857.

COLONEL THE HONOURABLE JAMES LINDSAY in the Chair.

ON THE GENIUS AND CAMPAIGNS OF HANNIBAL.

BY LIEUT.-COL. MACDOUGALL.

IN the present lecture I propose to bring down the narrative of the Second Punic War only so far as to the end of the first campaign in Italy ; that is to say, to the battle of the Trebbia, which naturally terminates the first epoch of that contest.

The Second Punic War was termed by the historian Livy the most memorable of all wars that ever were carried on. And there is no exaggeration in the expression, for a parallel to its incidents and achievements, as well as to the great importance of its results, is only to be found in modern history. That great struggle was to determine whether the world was to be ruled by Rome or Carthage.

On this subject the French historian Michelet, in his "*Histoire Romaine*," has the following passage.

"It is not without reason that so universal and vivid a remembrance of the Punic wars has dwelt in the memories of men. They formed no mere struggle to determine the lot of two cities or two empires ; but it was a strife, on the event of which depended the fate of two races of mankind, whether the dominion of the world should belong to the Indo-Germanic or to the Semitic family of nations. Bear in mind, that the first of these comprises, besides the Indians and the Persians, the Greeks, the Romans, and the Germans. In

the other are ranked the Jews and the Arabs, the Phœnicians and the Carthaginians. On the one side is the genius of heroism, of art, and legislation; on the other is the spirit of industry, of commerce, and of navigation. The two opposite races have everywhere come into contact, everywhere into hostility. In the primitive history of Persia and Chaldaea, the heroes are perpetually engaged in combat with their industrious and perfidious neighbours. The struggle is renewed between the Phœnicians and the Greeks on every coast of the Mediterranean. The Greek supplants the Phœnician in all his factories, all his colonies in the East: soon will the Roman come and do likewise in the West. Alexander did far more against Tyre than Salmanassar or Nebuchodonosor had done. Not content with crushing her, he took care that she never should survive: for he founded Alexandria as her substitute, and changed for ever the track of the commerce of the world. There remained Carthage—the great Carthage, and her mighty empire—mighty in a far different degree than Phœnicia's had been. Rome annihilated it. Then occurred that which has no parallel in history—an entire civilisation perished at one blow—vanished, like a falling star. The 'Periplus' of Hanno, a few coins, a score of lines in Plautus, and, lo, all that remains of the Carthaginian world!

“Many generations must needs pass away before the struggle between the two races could be renewed; and the Arabs, that formidable rear-guard of the Semitic world, dashed forth from their deserts. The conflict between the two races then became the conflict of two religions. Fortunate was it that those daring Saracenic cavaliers encountered in the East the impregnable walls of Constantinople, in the West the chivalrous valour of Charles Martel, and the sword of the Cid. The Crusades were the natural reprisals for the Arab invasions, and form the last epoch of that great struggle between the two principal families of the human race.”

In the destruction of Carthage perished almost all the documents which would have conveyed to posterity a full idea of the character and institutions of Rome's great rival. But we can perceive how inferior Carthage was to her competitor in military spirit, military resources, and position; and how far less fitted than Rome she was to become the founder of a dominion destined to exist for ages,

which should bind together barbarians of every race and language into an organised empire, and fit them for becoming, after that empire should be dissolved, the free members of the commonwealth of Christian Europe.

One great source of the inferiority of Carthage was that she had no native army. Her citizens were essentially, that which the English have sometimes been taunted with being, a trading people.

Michelet remarks: "The life of an industrious merchant, of a Carthaginian, was too precious to be risked, as long as it was possible to substitute advantageously for it that of a barbarian from Spain or Gaul. Carthage knew, and could tell to a drachma, what the life of a man of each nation came to. A Greek was worth more than a Campanian, a Campanian worth more than a Gaul or a Spaniard. When once this tariff of blood was correctly made out, Carthage began a war as a mercantile speculation. She tried to make conquests in the hope of getting new mines to work, or to open fresh markets for her exports. In one venture she could afford to spend 50,000 mercenaries, in another rather more. If the returns were good, there was no regret felt for the capital that had been lavished in the investment: more money got more men, and all went on well."

And commenting on this, Professor Creasy, in his most interesting and valuable work on the "Decisive Battles of the World," has the following eloquent passage:—

"Armies composed of mercenaries have, in all ages, been as formidable to their employers as to the enemy against whom they were directed. We know of one occasion (between the first and second Punic wars) when Carthage was brought to the very brink of destruction by a revolt of her foreign troops. Other mutinies of the same kind must, from time to time, have occurred. Probably one of these was the cause of the comparative weakness of Carthage at the time of the Athenian expedition against Syracuse; so different from the energy with which she attacked Gelon half a century earlier, and Dionysius half a century later. And, even when we consider her armies with reference only to their efficiency in warfare, we perceive at once the inferiority of such bands of Condottieri

brought together without any common bond of origin, tactics or cause, to the legions of Rome, which at the time of the Punic wars were raised from the very flower of a hardy agricultural population, trained in the strictest discipline, habituated to victory, and animated by the most resolute patriotism. And this shows also the transcendancy of the genius of Hannibal, which could form such discordant materials into a compact, organised force, and inspire them with the spirit of patient discipline and loyalty to their chief, so that they were true to him in his adverse as well as in his prosperous fortunes. And throughout the chequered series of his campaigns no panic rout ever disgraced a division under his command,—no mutiny or even attempt at mutiny was ever known in his camp—and finally after fifteen years of Italian warfare his men followed their old leader to Zama, ‘with no fear and little hope;’ and there on that disastrous field stood firm around him his Old Guard till Scipio’s Numidian allies came up on their flank, when at last surrounded and overpowered, the veteran battalion sealed their devotion to their general with their blood!”

Before entering on the relation of the Second Punic War, it will be well to give a short description of the armies of the two people who were engaged in it.

The general appearance of a Carthaginian army has been described by one of the historians of the period, as follows:

“It was an assemblage of the most opposite races of the human species, from the farthest parts of the globe. Hordes of half-naked Gauls were ranged next to companies of white-clothed Iberians, and savage Ligurians next to the far-travelled Nasomanes and Loto-phagi. Carthaginians and Phœnici-Africans formed the centre; while innumerable troops of Numidian horsemen, taken from all the tribes of the desert, swarmed about on unsaddled horses and formed the wings; the van was composed of Balearic slingers; and a line of colossal elephants with their Ethiopian guides formed, as it were, a chain of moving fortresses before the whole army.”

The Spaniards and Africans were armed with helmets and shields, and, for offensive weapons, with short cut-and-thrust swords. The Africans carried a spear in addition.

The Gauls carried long javelins and huge broadswords and

targets, similar to those described by Sir Walter Scott as having been the weapons of the Scottish Gael at a more recent period.

In the contest now under consideration, Hannibal's heavy infantry was composed of Spaniards, Africans, and Gauls; his light infantry, of the famous and formidable Balearic slingers and Gaulish irregulars. The only cavalry we read of as having accompanied him into Italy consisted of Numidian Irregulars, who were yet very formidable in the field, and the best scouts in the world. But after his entrance into Italy Hannibal organised a body of Gaulish heavy cavalry, which did him good service in his subsequent campaigns.

Rome, the iron kingdom of prophecy, was the greatest military power the world has ever seen; conquest was the breath of her nostrils; and her military organisation was the most perfect that has ever existed. The following extract from Gibbon enables us to understand by what means the Roman dominion was extended over the whole of the known world:

“ The Roman peasant, or mechanic, imbibed the useful prejudice that he received advancement in being permitted to enter the more dignified profession of arms, in which his rank and reputation would depend on his own valour; and that, although the prowess of a private soldier must often escape the notice of fame, his own behaviour might sometimes confer glory or disgrace on the company, the legion, or even the army, to whose honours he was associated. On his first entrance into the service, an oath was administered to him with every circumstance of solemnity. He promised never to desert his standard, to submit his own will to the commands of his leaders, and to sacrifice his life for the safety of the emperor and the empire. The attachment of the Roman troops to their standards was inspired by the united influence of religion and of honour. The golden eagle, which glittered in the front of the legion, was the object of their fondest devotion; nor was it esteemed less impious than it was ignominious to abandon that sacred ensign in the hour of danger. These motives, which derived their strength from the imagination, were enforced by fears and hopes of a more substantial kind. Regular pay, occasional donatives, and a stated recompense after the appointed time of service, alleviated the hardships of the

military life, whilst, on the other hand, it was impossible for cowardice or disobedience to escape the severest punishment. The centurions were authorised to chastise with blows—the generals had a right to punish with death; and it was an inflexible maxim of Roman discipline that a good soldier should dread his officers far more than the enemy. From such laudable acts did the valour of the imperial troops receive a degree of firmness and docility unattainable by the impetuous and irregular passions of barbarians.

“And yet, so sensible were the Romans of the imperfection of valour without skill and practice, that, in their language, the name of an army was borrowed from the word which signified exercise. Military exercises were the important and unremitted object of their discipline. The recruits and young soldiers were constantly trained both in the morning and in the evening, nor was age or knowledge allowed to excuse the veterans from the daily repetition of what they had completely learnt. Large sheds were erected in the winter-quarters of the troops, that their useful labours might not receive any interruption from the most tempestuous weather; and it was carefully observed that the arms destined to this imitation of war should be of double the weight which was required in real action. It is not the purpose of this work to enter into any minute description of the Roman exercises. We shall only remark that they comprehend whatever could add strength to the body, activity to the limbs, or grace to the motions. The soldiers were diligently instructed to march, to run, to leap, to swim, to carry heavy burdens, to handle every species of arms that was used either for offence or for defence, either in distant engagement or in a closer onset; to form a variety of evolutions; and to move to the sound of flutes in the Pyrrhic or martial dance. In the midst of peace, the Roman troops familiarised themselves with the practice of war; and it is prettily remarked by an ancient historian who had fought against them, that the effusion of blood was the only circumstance which distinguished a field of battle from a field of exercise. It was the policy of the ablest generals, and even of the emperors themselves, to encourage these military studies by their presence and example; and we are informed that Hadrian as well as Trajan frequently condescended to instruct the inexperienced soldiers, to reward the

diligent, and sometimes to dispute with them the prize of superior strength or dexterity."

In our own day, and in our own country, we may congratulate ourselves in having at the head of the army a royal prince, who has given the strongest evidence of his disposition to encourage and even to enforce all necessary military studies and exercises; and as the British soldier is in nowise inferior to the Roman legionary in strength, courage, or devotion, there is little doubt that, although we are not a military people, if the earnestness and energy of the Commander-in-chief be only emulated by his officers, the English army will have no reason to dread a comparison with any force either of ancient or modern days.

The Roman legions during the Second Punic War differed from those with which Cæsar effected his conquests 150 years later. The constitution of the legions which fought against Hannibal was as follows :

The infantry amounted to about 5,000 men. They were formed in three lines, at the distance from each other of about 100 yards, with the light-armed troops in skirmishing order in front of the whole. The first line consisted of the *Hastati* numbering 1,600 men. The second line of the *Principes* of the same strength. These were armed in the same manner. Each soldier wore a breastplate or coat of mail, brazen greaves, and a brazen helmet with a lofty crest of scarlet or black feathers, and carried a large oblong shield. His offensive weapons were a short cut-and-thrust sword, like that used by the Spaniards, worn on the right thigh; and in his hand besides a light spear he grasped the formidable *pilum*. This weapon was a ponderous javelin nearly eight feet long, having a shaft of four feet and an iron head of nearly equal length; and, although very inferior to the musket, since it was capable of only one discharge, yet when it was launched by a strong and practised hand at the distance of ten or twelve paces, there was not any shield or breastplate that could sustain its shock.

The third line was composed of 600 veteran soldiers called *Triarii*, who carried the same equipment as the men of the two first lines, except that in place of the two javelins they bore a spear: they may be regarded as the reserve. The light-armed troops must

therefore have amounted to 1,200 men, in order to complete the legionary infantry.

Each line was drawn up in eight ranks, or eight deep. The men of each rank stood three feet apart, and there was an interval of three feet between the ranks ; but the men of each rank, instead of covering those in front of them, covered the intervals, so that the legionary infantry was formed in what is called quincunx order, or precisely in that formation which would be taken by several ranks of our own men preparatory to performing the sword exercise. Niebuhr supposes that this order was adopted for the purpose of enabling the men of the front rank to be easily reinforced or relieved after they had hurled their pila by those of the remaining seven ranks in succession, so as to keep up a continual discharge of these weapons if required, or to enable the same change to be made when fighting with the sword, which was always drawn as soon as the pilum was discharged.

A small body of cavalry formed a component part of each legion ; but it was always found necessary to raise independent bodies of cavalry to act with the Roman armies, the legionary horse, 300, being only sufficient for outpost and foraging duty.

Every Roman legion of the strength above described had in the field attached to it a legion of the Italian allies of the same strength and organization, so that we may always compute about 10,000 men, besides cavalry, for every Roman legion employed against an enemy.

I now turn to the relation of the events which immediately preceded, and which were the origin of, the Second Punic War.

Hannibal the son of Hamilcar, surnamed Barca or the thunderbolt, was with his father in Spain during the interval which elapsed between the First and Second Punic Wars ; and he was only nine years old at the time when he took that famous oath of enmity against Rome which he so religiously kept in after-life.

Hamilcar commanded the Carthaginian armies in Spain with uninterrupted success for nine years. The expedition to that country was originally undertaken at his instance, because he foresaw that no long time could elapse before Rome and Carthage would again be enemies. He was sensible that Carthage was weak in consequence

of her having no native army; and he designed not only to train his existing army in a constant warfare against the bravest of barbarians, but to effect permanent conquests in Spain. It was his policy to attach the new subjects to the mother city by kind treatment, at the same time that he conciliated the native independent princes; and he hoped thus not only to ensure a constant supply of good soldiers to recruit his armies, but, by gaining possession of the productive gold and silver mines of the south of the Peninsula, to obtain the means of paying them.

Hamilcar was slain in battle in the year B.C. 229, it is supposed in the country between the Tagus and Douro rivers, to which he had pushed his conquests. Hasdrubal, his son-in-law, appears to have inherited not only his command, but also his spirit and genius. He consolidated the conquests of Hamilcar no less by his policy than by the influence of his personal manners and character; and he accommodated himself so successfully to the feelings and habits of the Spaniards which he had carefully studied with that view, that the native chiefs far and near vied with each other in their eagerness to become the allies of Carthage.

Rome watched the progress of Hasdrubal with uneasiness; and, as the threatening of a Gaulic invasion at that time rendered it inexpedient to have recourse to arms, she endeavoured to secure herself by a treaty, the provisions of which bound Hasdrubal not to push his conquests beyond the Iberus and obliged each of the contracting parties to abstain from molesting the allies of the other. The city of Saguntum had lately placed itself under the protection of Rome, and was therefore by the terms of the treaty secure from attack, although situated so far south of the Iberus. The Romans hoped doubtless by its means to obtain a more forward footing in Spain, from which, when the Gaulic war should be terminated, they might sap the newly-formed dominion of Carthage in that country.

Hasdrubal was assassinated in the year 221 B.C., after a successful administration of the affairs of Spain during eight years; and now Hannibal at the early age of 24, by the unanimous voice of the soldiers, was called to the chief command of the Carthaginian forces in Spain; and the Senate of Carthage ratified the choice of the army.

Two years were occupied with expeditions against the native tribes of the interior ; but in the third year Hannibal, having matured his plans, resolved to provoke a war with Rome by besieging Saguntum. He accordingly laid siege to that city ; and, although left entirely to its own resources by its covenanted protectors, it was no sooner taken after an heroic defence of eight months, than the Romans sent ambassadors to Carthage to demand that Hannibal and his principal officers should be delivered up to them for their infraction of the treaty.

In default of compliance with that demand the Second Punic War was declared, B.C. 218.

This short introduction has been necessary in order to convey a clear understanding of the progress of that great struggle ; for it will be seen that the event was materially influenced by the operations in Spain at different periods of the contest.

Long before the declaration of war Hannibal had been maturing in his own mind his great project of the invasion of Italy, and had neglected no measure which could conduce to its success. He had sent emissaries through Gaul and across the Alps into Cisalpine Gaul, in order to sound the dispositions of the inhabitants along the route he proposed to follow, and to secure for his army a friendly reception from the Cisalpine Gauls on its descent from the Alps. He well knew the character of that lively and fickle people, and their hatred of the Romans, and he trusted to his own genius to convert their friendly feelings towards himself into active and faithful co-operation.

It was late in the month of May, B.C. 218, that Hannibal set out from New Carthage on his great undertaking ; and, "thus," in the beautiful language of Arnold, "with no divided heart, and with an entire resignation of all personal and domestic enjoyments for ever, Hannibal went forth at the age of twenty-seven to do the work of his country's gods, and to redeem his early vow."

The force with which he quitted New Carthage amounted to 30,000 foot and 12,000 horse. He crossed the Iberus, and might have advanced without loss of time to the Pyrenees, but the country between the Iberus and those mountains was friendly to the Romans. Some of its towns held Roman garrisons ; it therefore

became necessary to subdue this district entirely, and thereby to deprive the Romans of a convenient base of operations from which they might otherwise attack the Carthaginian conquests in Spain.

Hannibal effected this object speedily but at a terrible loss of life, and having left Hanno with 11,000 men to guard his new conquest and sent an equal number of his Spanish soldiers back to their homes, he crossed the Pyrenees and entered Gaul with an army, which was now reduced by these detachments, and the losses it had sustained in the field, to 50,000 foot and 9,000 horse.

From the Pyrenees to the Rhone his progress was easy, an unmolested passage through their territories being purchased by presents to the native chiefs. But the passage of the Rhone was not to be effected without opposition, for the city of Massilia (the modern Marseilles) was a fast ally of Rome, and its influence had been successfully exerted with the neighbouring tribes of the eastern bank to induce them to oppose the progress of the invader. Besides this, P. Scipio, one of the Roman consuls for the year, had lately arrived off the mouth of the Rhone with a fleet and army on his way to Spain; and learning there that the Carthaginian army had actually passed the Pyrenees, he disembarked his force, with the intention of opposing Hannibal on the Rhone and in the hope of preventing his advance beyond that river.

Hannibal, in his march through Gaul, kept his army as far as possible away from the sea-coast in order to conceal his movements from the Romans; and Scipio, hearing nothing of him and believing that his progress must necessarily be slow, lingered at the mouth of the Rhone at the very time when the friendly tribes of the eastern bank were vainly endeavouring to prevent Hannibal's passage of the river. Scipio contented himself with sending forth three hundred light cavalry to ascend the left bank of the Rhone, and to endeavour to gain some information of the movements of the invading army.

Hannibal is supposed to have struck the Rhone at a point about half-way between its mouth and its confluence with the Isara (the modern Isère). He immediately purchased all their boats and vessels of every kind from the inhabitants of the western shore; and, having constructed others of the timber which abounded on the spot, he in two days possessed sufficient transport to ferry his whole

army across the river. But he found the Gauls of the opposite shore assembled to oppose his passage, and his dispositions to effect it are well worthy of attention.

He sent off a strong detachment by night with native guides, to ascend the river for about twenty miles, and then to cross as best they could, where there would be no enemy to oppose them. This detachment selected a part of the river where its course was divided into two narrow channels by an island; and these effected the passage without difficulty by means of rafts constructed of timber which was found on the spot.

Hannibal, by previous concert, waited forty-eight hours from the time when the detachment left him; and then, on the third morning from that time, made all his preparations for the passage of his main body. The first division was assembled in the boats and only awaited the signal agreed upon to push off. That signal was the smoke of a great fire kindled by the detachment which had crossed the river, and which had now marched down to within a short distance of the barbarians on the opposite bank, whose whole attention was engrossed by the sight of Hannibal's preparations, and who crowded down to all the accessible parts of the river shore to oppose his landing. The first division now pushed off. The Rhone was full and rapid. The largest and heaviest vessels were placed highest up stream to serve as a breakwater to the others. The men pulled vigorously against the current, and, as the flotilla approached the opposite bank the attention of the Gauls was diverted to a mass of fire which appeared in their rear; and now the detachment which had kindled it charged upon their right flank and rear at the same time that the flotilla stranded, and the soldiers, at whose head was Hannibal, leaping ashore, attacked the bewildered barbarians in front. These made a feeble resistance and fled in confusion. The boats were instantly sent back for the second division, and before nightfall Hannibal's whole army, with the exception of the elephants, was encamped on the eastern bank of the Rhone.

Early next morning Hannibal sent out some Numidians to ascertain the position of Scipio's army. Not many hours elapsed before these horsemen were seen returning to the camp as if riding for their lives from a pursuing enemy. They had indeed fallen in

with the light cavalry sent out by Scipio, who had attacked and driven in the Numidians, and who now, as soon as they came in sight of the Carthaginian camp, wheeled about to carry back tidings to their general.

Scipio now no longer delayed to put his army in motion to oppose Hannibal, but he was already too late; for, when he reached the place which had been the site of the Carthaginian camp, he learnt that Hannibal had quitted it three days before, and had marched northwards up the Rhone. To have followed him through an unknown country, whose inhabitants as Gauls probably hated the Roman name, would have been madness; for it must be remembered that the tribes which opposed him on the Rhone were in the neighbourhood, and under the influence of Massilia.

Scipio therefore perceiving it was no longer possible to prevent Hannibal from reaching the Alps, resolved to meet him in Italy on his descent from those mountains, when he hoped that the Carthaginian army, exhausted by the fatigues and privations inseparable from such a march, and diminished in numbers, would be easily vanquished by the Roman forces which were already assembled in Cisalpine Gaul.

Scipio accordingly again descended the Rhone, and, having despatched his army to Spain under the command of Cneus Scipio as his lieutenant, sailed himself to Pisa, whence he proceeded across the Apennines to take command of the Roman legions which were stationed on the Po under the prætors Manlius and Atilius, whose force amounted to about 25,000 men.

Meanwhile on the day after the sudden apparition of the Roman cavalry, Hannibal, having with some difficulty effected the passage of the elephants, broke up his camp and marched northwards, covering the rear of his line of march with his cavalry and elephants, for he believed Scipio to be in his immediate neighbourhood, and expected to be pursued.

The precise direction of his march is uncertain; but it appears probable that after having espoused the cause of one of two brothers near Valence, who contended for the chieftainship of their tribe, and having received from the successful competitor in return important succours in the shape of provisions, arms, clothing, and above all of

shores—the Carthaginian army crossed the Isère—and, still proceeding for some distance up the left bank of the Rhone, at length struck off to the right across the plains of Dauphiné, and reached the first ascent of the Alps.

This was near the northern extremity of that ridge of limestone mountains which, rising suddenly out of the plains to a height of 5,000 feet, fills up the space between the Rhone at Belley and the Isère below Grenoble, and separates the plains of Dauphiné from the rich and wide valley extending from the Lake of Bourget to the Isère at Montmeillan. At the place where Hannibal crossed this ridge it is of no great width. His progress was opposed by the natives who guarded the defiles through which he must pass; but learning that these only guarded them during the day, and at night withdrew to their homes in the valley beyond, he seized the defiles after nightfall, and on the next day effected the passage of his army, not without being attacked however, and penetrated into the valley of Montmeillan. This town he took by storm. It was the principal stronghold of the barbarians, and in it he found large supplies of provisions and cattle.

Halting there for one day to rest his men, he then proceeded for three days up the right bank of the Isère. He was now met by a deputation of the natives who professed to be friendly, and having received from them supplies and hostages for their good behaviour, he was induced by their plausible conduct to accept of their guidance through a difficult part of the mountains to which he was approaching. Here he narrowly escaped destruction from an attack made upon him by his treacherous friends at the most difficult part of the way; but at length all obstacles were surmounted, and on the ninth day after quitting the plains of Dauphiné, Hannibal and his army stood on the summit of the central ridge of the Alps, supposed to be the summit of the little St. Bernard Pass.

The period of the year was about the end of October—the first winter snows had already fallen—and the climate of the country being far more severe than at present owing to the dense forests which at that time covered the face of Germany, Hannibal's southern soldiers must have been in dreary quarters. It is probable

that great numbers perished from cold, and certain that all must have been much worn and disheartened, for many mountain peaks still rose between them and Italy, through which their descent was likely to be both perilous and painful. But Hannibal's ascendancy over his men was complete, and after a rest of two days he resumed his march.

No more open hostility was manifested by the natives, but the natural difficulties of the route were greater than ever. The snow concealed the track, so that many losing it fell over frightful precipices. At last the army came to a place where the track had been carried away by an avalanche for a distance of 300 yards. It was impossible to turn this obstacle by scaling the heights above on account of the great depth of snow, and nothing remained but to reconstruct the road.

A summit of some extent was found and cleared of snow, on which the army encamped, and all working for their lives, succeeded in completing in one day a practicable road for the cavalry and baggage animals, which were immediately sent on to encamp in a valley beyond; but for the passage of the elephants a wider and more solid way was required, and its construction occupied two days more, during which both men and elephants suffered terribly from cold and want.

At length all passed safely, and after a further toilsome march of three days, the army cleared the mountains and entered the territory of the Insubrian Gauls, messengers from whom had previously met Hannibal on the Rhone to assure him of a friendly reception in their country.

The valley by which Hannibal is supposed to have descended into Italy is the Dorea Baltea, the same by which Napoleon penetrated with his famous army of reserve in the Marengo campaign.

The principal difficulties of this march arose from the lateness of the season. Had the summit of the Little St. Bernard been reached a month earlier, no fresh snow would have fallen and fodder might have been procured for the cattle without difficulty. The commissariat labours must have been very great, as provisions had to be carried for about 30,000 men and 8,000 cavalry horses; besides

what was required for the baggage and pack animals, which could not have numbered less than 5,000 or 6,000.

Hannibal carried with him out of the mountains only 12,000 African and 8,000 Spanish infantry, the remnant of 50,000 with which he quitted Spain. His cavalry too had dwindled from 9,000 to 6,000 horses.

He gave his army the rest its exhausted condition required, and, having recruited its strength, his first expedition was undertaken against the Taurinians of Liguria who were hostile to the Insubrians, and would not, on that account, listen to the proposals of Hannibal to join him against the Romans. He took and sacked their chief city, Augusta (the same as modern Turin), and struck such terror into the neighbouring tribes that they submitted and became his allies.

It is now time to turn our attention to the preparations the Romans had been making in the interval between Hannibal's departure from Spain and his arrival in Italy, and to the forces they had assembled to oppose their great enemy.

The two Consuls of the year were P. Scipio and Ti. Sempronius. Scipio's province was Spain, and it has been already related how, after his unsuccessful endeavour to stop Hannibal on the Rhone, he despatched his army to that province while he himself went to command on the Po.

Sempronius, with another consular army, was destined to cross over into Sicily, and thence, if circumstances were favourable, to make a descent on Africa, in the hope by threatening Carthage to recall Hannibal to its defence. But Hannibal had not neglected among his other preparations to provide against such a contingency. Before he quitted Spain fresh troops were at his suggestion sent to that country from Africa, to be commanded during his absence by his brother Hasdrubal, while he sent Spanish soldiers to defend the territory of Carthage, in order that the soldiers of each nation being quartered among foreigners, should be deprived of the temptation or opportunity to revolt.

He was also in all probability actuated by the consideration that his bitterest enemies were to be found in that faction of his fellow-citizens which was headed by Hanno. And he was therefore not

sorry to hold that faction in check by the presence of a force which, on account of its personal attachment to himself, owed an allegiance to Hannibal rather than to Carthage.

A third army consisting like the two first of two Roman legions, and the usual proportion of allies, and amounting to about 20,000 men, was sent to Cisalpine Gaul under the Prætor L. Manlius; and in order further to restrain the disaffected Gauls the military colonists of two Roman colonies to the number of 12,000 men, were despatched to occupy the important posts of Placentia and Cremona, on opposite sides of the Po. Thus the Roman force which was actually assembled in Cisalpine Gaul so early as the end of May of the year 218, amounted to 32,000 men, and was considered amply sufficient to preserve tranquillity. But, before Scipio had set out from Rome to assume his consular command, news arrived that the Boian and Insubrian Gauls had risen, that they had defeated Manlius and blockaded him in one of his towns, and that they had, moreover, dispersed the colonists of Placentia and Cremona, and driven them to take refuge in Mutina, another Roman colony on the road between Placentia and Ariminum.

One of Scipio's legions was immediately sent off under another prætor Caius Atilius, to relieve and reinforce Manlius, while Scipio's army was raised to its original strength by new levies.

Thus when Scipio arrived in Cisalpine Gaul towards the end of the year, he found the army of the prætors in the field, amounting to about 25,000 men, and the military colonists re-established in Placentia and Cremona; and it was of this aggregate force that he took the command.

It was now the middle of December, and unusually late for military operations; but Scipio, being anxious by a rapid advance to prevent a general rising of the Gauls in favour of Hannibal, crossed the Po at Placentia and marched up its northern bank; while Hannibal on the other hand knowing well that the Gauls were prevented from joining him by fear alone, and certain that his first success against the Roman arms would draw multitudes to his standard, descended the northern bank to meet Scipio, who, having crossed the Ticinus by a bridge he had constructed, continued to advance westward with the river on his left.

Thus was brought on accidentally a cavalry action, which has been magnified by the name of the battle of the Ticinus, in which the Numidians supported by the Gaulish heavy cavalry completely defeated the Roman horse, and in which Scipio himself was dangerously wounded. Here was first established the superiority of the cavalry of Hannibal over that of the Romans, to which he owed much of his subsequent success; and the country being level and open, and peculiarly favourable to the action of that arm in which they were so evidently inferior, the Romans retired behind the Ticinus over the bridge which they had made, and which they now broke down behind them; but this operation was attended with so much confusion that 600 men were left on the wrong side of the river and fell into the hands of the enemy.

Hannibal, not judging it prudent to attempt the passage of such a river as the Ticinus in the face of the Romans, retraced his steps up the northern bank of the Po until he found a convenient place, where he transported his army to the southern bank by means of the river boats. The Romans, now fearing to be turned, and lest Hannibal should reach Placentia before them, retreated in all haste on that city, and encamped under its walls.

Hannibal marching down the Po came in sight of the Roman camp two days after crossing the river, and, after vainly endeavouring to provoke the enemy to an engagement, he placed his army about five miles to the south-east of Placentia, cutting off Scipio's communication with Ariminum and Rome. Hannibal was here in a friendly country, for, as he expected would be the case, he was received with open arms by the natives on the south of the Po, and indeed the Romans had no hold on the territory of Cisalpine Gaul but by their garrisons or colonies.

Hannibal's appearance in Italy took the Roman Senate by surprise. They judged that the difficulties of the march must delay his arrival until the following spring. But they no sooner received intelligence that he was actually in Italy, than they sent for Sempronius and his army from Sicily, and despatched them to reinforce Scipio on the Po.

Sempronius was with his army at Lilybæum the furthest point of Sicily, when he received his orders, and it may give a small

idea of the immensely increased facilities which science has imparted to military operations, that—rather than encounter the dangers of a winter navigation of the Adriatic—instead of embarking at Lilybæum and sailing to Pisa—the troops marched through Sicily to Messina, there crossed the straits, and proceeded through the whole length of Italy by Ariminum to the scene of conflict on the Po, which they reached in about forty days. In our time the operation would have been effected in four, including the march from Pisa across the Apennines.

Sempronius effected his junction with Scipio unimpeded by Hannibal, and the army of the consuls then moving westward crossed to the left bank of the Trebbia, where it encamped. This movement was probably effected by the Romans in order to draw near the magazines, of which they possessed several, south of the Po; and on which they depended for their subsistence; for, as it has been already remarked, they had no hold on the country excepting by their garrisons, and without these the Roman army might have starved, while Hannibal had all his wants amply supplied by the good will of the inhabitants.

The army of the consuls amounted to about 40,000; and that of Hannibal had been so reinforced by the accession of the Gauls since its descent from the Alps, that it was little, if at all, inferior in numbers. It was Hannibal's policy to bring on a decisive battle as soon as possible. It is true the Gauls were friendly and furnished all his wants; but they were proverbially fickle; they were impatient to share in the plunder of Roman territory, and they would naturally chafe at a delay, the effect of which was to throw the burden of supporting the Carthaginian army exclusively upon them.

To force the Romans to a battle Hannibal attacked their magazines. One of the principal of these, Clastidium, was betrayed into his hands by the treachery of its Governor, and in it he found large supplies of corn. After this the Carthaginian army encamped on the right bank of the Trebbia, opposite to and within sight of the Roman camp. As Scipio was still disabled by his wound received at the Ticinus, the sole command of the Roman army devolved on Sempronius, who was no less eager to fight than Hannibal; and he

is not to be censured for rashness in desiring to bring on an engagement—for the hostile armies were equal in strength, and Hannibal's transcendent genius was as yet unproved—but for the entire disregard of all military rules he evinced in conducting the operation.

Early in the morning, Hannibal, having encamped his army on the opposite bank of the Trebbia within sight of the Romans, sent his Numidians across the river to skirmish with the Roman horse, and, if possible, to entice the Romans by retreating to cross the river in pursuit. He had previously posted his brother Mago with 2,000 picked men in an ambush in the overgrown bed of a water-course, in such a position that when passed by the Romans in their advance after crossing the river, Mago might burst out upon their flank and rear while Hannibal engaged them in front.

Sempronius fell into the snare ; he ordered first his cavalry, and then his whole army, to follow the flying Numidians across the river. It was mid-winter, bitterly cold, and the stream ran breast-high. It is said the Romans had not broken their fast ; and thus wet, exhausted, and half frozen, Sempronius after crossing formed his troops in order of battle with the river in their rear.

Meanwhile Hannibal's men had breakfasted, and formed leisurely to meet the enemy's attack.

The Romans as was their custom were formed in three lines, with the cavalry, only 4,000 strong, on the flanks, in the order which has been described in the introductory remarks.

Hannibal drew up his army in two lines. In the first were his light troops and Balearic slingers ; the second line was composed of his heavy-armed African, Spanish, and Gaulish infantry, amounting to about 20,000 men.

The elephants, and the cavalry 10,000 strong, were divided between the wings.

The battle was opened as usual by the light troops, and the Roman Velites, already exhausted with their morning work, were soon driven through the intervals of the maniples to the rear. The Roman cavalry too, charged by the elephants and by the greatly superior hostile cavalry, was broken immediately and driven off the field. But when the Roman infantry came to close their courage and discipline seemed capable of restoring the balance ; but

at this critical moment Mago's ambush burst on their rear; while the Carthaginian cavalry charged both their flanks, and Hannibal pressed them in front. No troops could withstand such an onset. The centre legions indeed, overbearing all opposition, burst through their opponents and marched clear off the field to Placentia, but the remainder were driven back into the Trebbia with tremendous slaughter.

Only a small remnant reached the opposite bank; and Scipio after nightfall leading this remnant once more across the river, passed the enemy in the dark and joined his colleague within the walls of Placentia.

Thus ended Hannibal's first campaign in Italy; and I propose to conclude this Lecture with a few critical remarks on the events which have just been related.

REMARKS.

1. Hannibal's sagacity is evidenced by his resolution to provoke a war with Rome. He was well aware of the moral force which attaches generally to the initiative in war; and he perceived also that the relative circumstances of the two powers lent a particular value to the initiative in the present instance. In the First Punic War all the success had been on the side of the Romans, and the tide of fortune had set in too strongly in their favour to admit of its being turned by the genius of Hamilcar, who was advanced to the command of the Carthaginian armies too late for that purpose. In consequence of their successes in that war, Hannibal calculated that the Romans, reposing in a haughty security, would be very slow to believe that their despised enemies would willingly engage with them in a second struggle. Hence the Roman apathy in permitting Saguntum to fall without any more active attempt at its relief than the remonstrance of an envoy. Hence also the time that was lost to Rome, and gained by Hannibal for his preparations, in sending ambassadors to Carthage to demand an explanation after the fall of Saguntum, in place of immediately declaring war and accompanying that declaration with an invasion of Africa, for which purpose Sicily would have served as a convenient stepping-stone and base of operations.

Such an energetic proceeding on the part of Rome would have occasioned the recall of all the Carthaginian forces from Spain, and the consequent loss of all the fruits of the Carthaginian conquests in that country ; and Carthage would have commenced the war much in the same relative position as that which she occupied at the beginning of the first Punic war.

On the other hand if the Carthaginians took the initiative all the advantages would be for them. Hannibal calculated that, if he could once cross the Alps with an army, he could so work upon the hatred to Rome which was the universal feeling among the Cisalpine Gauls, as to convert that fickle people into zealous allies, and their territory into a base for his subsequent operations ; he hoped also to derive advantage from the constitution of the different states of Italy which were in alliance with, and dependent on, the Roman Republic. Though called by the name of allies they were in reality subjects ; and, although the existing generation in those states had grown up in peace with the Romans, their constrained alliance had not quite extinguished the old feelings of hatred and rivalry.

Hannibal counted on the influence of those feelings combined with the prestige of the victories he hoped to gain, to aid in detaching the allies from their fidelity and to isolate the Roman Republic proper in the midst of a surrounding hostile population. He saw that all depended on the initiative ; and that if he could once gain a footing in Italy, as it were by surprise, he might afford to disregard any diversion his enemies might attempt to make by threatening Carthage.

2. It has been related that immediately before he crossed the Pyrenees Hannibal sent 11,000 of his Spanish soldiers back to their homes. This measure is an instance of that great knowledge of human nature which alone could have enabled him for so many years to rule an army composed of such discordant materials, so that "throughout the chequered series of his campaigns no mutiny, or even attempt at mutiny, was ever known in his camp." The explanation is as follows :—In the march to the Pyrenees about 3,000 Spaniards, frightened by the perils of the enterprise, deserted. Hannibal, sensible of the impolicy of attempting to prevent further desertion by severe measures which would indicate distrust, and feeling that unwilling troops weaken rather than strengthen an army,

gave out that he had himself sent the deserters to their homes as a reward for faithful service, and gave leave to 8,000 men on whom he could least depend to follow their comrades.

He thus took away the great inducement to depart; at the same time that he rid himself of doubtful followers whose bad spirit might have inoculated the remainder. This proceeding is one instance of the great value set upon moral agents in war, not only by Hannibal, but by every one who has the least pretension to be called a great general.

3. Scipio's apathy in remaining quietly at the mouth of the Rhone after he had ascertained that Hannibal had actually entered Gaul, is not to be excused. No pains should have been spared by him to discover the position of the enemy and the line of march by which he might be expected to approach the Rhone. He should have sent out his light cavalry to scour the country on the western bank of the Rhone, to bring him intelligence of the approach of Hannibal in sufficient time to enable him to co-operate with the friendly tribes of the eastern bank in defending the passage of the river. To facilitate this object it was necessary to occupy as central a position as possible. Probably one about midway between the sea and the Isara would have been best chosen.

When it is required to defend a long line—suppose the line of a river, and the point at which an enemy may approach it is uncertain—the general of the defensive force should not attempt to defend every practicable point of passage, for that would be impossible; and, even though it were possible, such a proceeding would too much disseminate his force, and would expose the separated fractions to be beaten in detail supposing the enemy to succeed, as it is most probable he would do, in effecting his passage somewhere. In such a case the general of the defensive force should keep his troops well in hand in some central position, lining the banks with his light troops to observe the approach and the intentions of the enemy. It should then be his aim to come down suddenly on the enemy while in the act of forming his bridge,—or, better still, after a part only of the hostile force should have crossed.

Failing in this, he should previously have named some convenient point of concentration in rear of his general line, commanding the

line by which the enemy must advance, where the defensive army in a strong position might successfully dispute the further advance of the enemy, and defeat him with the river in his rear.

Had Scipio occupied such a central position as has been supposed in the first instance, and, failing thereby to prevent the Carthaginian army from crossing the Rhone, had he concentrated his force in a strong position in the rear, Hannibal could not have reached the Alps without fighting a battle. It was the Roman game to oblige Hannibal to fight as often as possible at a distance from Italy, and thereby to cripple him before he could reach the theatre of his intended operations.

The passage of a great river in presence of an enemy is a great military operation. It may be effected either by main force, or by stratagem in deceiving the enemy as to the intended point of passage ; or, as Hannibal here exemplified, by a combination of both.

In general the passage of a great river which is defended by an enemy, is effected either by stratagem, or by force and stratagem combined.

In such a case, having divided the enemy's attention by demonstrations made by your light troops at various points along the river front, and having attracted his particular notice to some false point by manœuvres calculated to that end, you should then direct your columns as rapidly as possible on the real point previously selected, and throw your bridge across.

Alexander's passage of the Hydaspes is a striking illustration of these remarks, and there is a resemblance between that operation and Hannibal's passage of the Rhone, inasmuch as in both cases the first passage was won by troops detached to a distance from the main body, which afterwards moved down on the flank of the defensive force.

4. The resolution which Scipio took to send his army to Spain, its original destination, instead of carrying it back with him to Italy, shews that he was possessed of some of the qualities which go to make up a great general ; particularly of that enlarged general view, without which a man may be an excellent tactician, but can never become a great commander. It is probably one of the rarest qualities of a general, the power of classifying in his own

mind the various events and circumstances which may influence the fate of a campaign, and giving to each no more than its due weight. It is to this faculty the great Napoleon alludes when he says: "The first quality of a general-in-chief is to have a cool head which receives only a just impression of objects; he should not allow himself to be dazzled either by good or bad news. The sensations which he receives successively or simultaneously in the course of a day should be classed in his memory so as only to occupy the just place due to each; for reason and judgment are the resultant of the correct comparison of many sensations. There are some men who, on account of their physical and moral constitution, make a single picture to themselves of every event; whatever knowledge, wit, courage, and other qualities they may possess, nature has not called them to the command of armies and the direction of great military operations."

Scipio foresaw that if the Carthaginians were unopposed in Italy, and had leisure to consolidate and to organise their conquests there, the safety of Rome would always be threatened, notwithstanding that Hannibal's army might be expelled from Italy, for the productive gold and silver mines of the Peninsula would constantly replenish the Carthaginian treasury; while the inhabitants—the best and bravest of barbarians, who were capable of becoming under the training of Hannibal and his brother equal to the best soldiers in the world—would afford a constant supply of recruits to the Carthaginian armies.

Arnold says: "Had Publius Scipio, at this critical juncture, not sent his army to Spain, instead of carrying it back with him to Italy, his son would in all probability never have won the battle of Zama." And indeed the progress of this narrative will demonstrate it to be more than probable, that if the Carthaginian forces, which were occupied in withstanding the Roman legions in Spain, had been at liberty to reinforce Hannibal in Italy, Rome could not have maintained the contest.

5. The position which Hannibal took up to the south-east of Placentia between the Roman army and Ariminum would have been in violation of the rules of war, if Hannibal had not been in a friendly country and therefore able to march and encamp in any

direction secure of obtaining supplies from the country-people. The violation of military rules would have consisted in this, that, although Hannibal had placed himself on the enemy's communications with Rome, the Roman army was based on Placentia, and it had moreover several magazines in the neighbourhood from which it could draw its subsistence, while its position intercepted Hannibal's communications with the country of the Insubrian Gauls, to which he must have looked as his base if the country south of the Po had not been also friendly.

But under the circumstances it was a masterly manœuvre, for Hannibal thereby placed himself between Scipio and the advancing army of Sempronius; and he doubtless did so with the intention of intercepting Sempronius, and of destroying him before he could unite with Scipio. Why he did not execute that intention it is impossible to explain. We learn that Sempronius marched from Ariminum and effected his junction with Scipio near Placentia. We know that Hannibal could not have been restrained by the weakness of his force, for he shortly after engaged the two consuls united; and he ought not to have failed from ignorance of the march of Sempronius for he had a numerous and excellent light cavalry in the Numidians who were the best scouts in the world. Whatever the explanation may be of his permitting Sempronius to pass him and to join Scipio, if it proceeded from any fault of his, which is very improbable, he speedily redeemed it.

6. The conduct of Sempronius at the battle of the Trebbia is a remarkable instance of military incapacity. In war it is an axiom that every possible chance should be enlisted on your side. But the generalship of Sempronius arrayed every chance against him. Instead of leading into action men fresh and vigorous, his soldiers, fatigued with struggling through the deep cold water, fasting and nearly frozen, were launched against Hannibal's troops in the full vigour of their strength. This was "taking the bull by the horns" with a vengeance; and the river which the Romans crossed to engage the enemy added immensely to their losses when they recrossed it to escape from him. It is a maxim that you should never fight with a river or defile in your rear, because, although you may be victorious, in such a position defeat would be ruin;

and it is conceivable that even your chances of success would be diminished thereby, for men are not likely to fight so freely when they know their retreat is not secure.

7. The bravery and discipline of the Roman infantry which broke through the troops opposed to it and marched clear off the field at Placentia were admirable. With Hannibal's numerous cavalry it is difficult to understand how he allowed this body to reach Placentia—it certainly seems that he should have prevented its doing so. A parallel to this march is to be found in the magnificent retreat of the three regiments of the Light Division under Crawford across the plain of Fuentes d'Onoro, in the face of an overwhelming force of 5000 cavalry, 15 guns, and a large body of infantry in support.

8. The confidence Hannibal felt in the superiority of his own genius is manifested by his plan for fighting at the Trebbia.

In judging of ordinary men we should be inclined to censure the inactivity which permitted the Roman army to cross the river and to form leisurely on the bank, without taking advantage of the confusion necessarily occasioned by such an operation to attack and defeat it, when landing, before it could recover from that confusion. A general less self-confident than Hannibal, when about to engage his troops against an untried enemy, would have availed himself of the above most obvious and certain method of inflicting defeat. But Hannibal's policy was not only to defeat, but to destroy; and by the moral effect of the annihilation of his foe to intimidate the Romans, at the same time that he thereby confirmed his new-found allies in the belief that they would consult their best interests by remaining faithful to him. Had Hannibal attacked the Romans during their passage of the river their defeat would not have been less certain but it would have been less decisive both in fact and in its moral effect. A much smaller number of Romans would have fallen; and both they and Hannibal's allies might have entertained, the one a boast, the other the reflection, that had the terrible Roman legions been arrayed against Hannibal on a fair field the result might have been very different.

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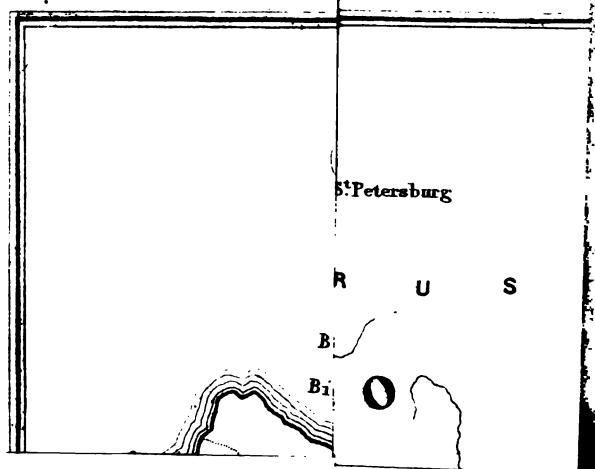
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Friday, July 31st, 1857.

COLONEL THE HONOURABLE JAMES LINDSAY in the Chair.

ON THE POLITICAL, MILITARY, AND COMMERCIAL IMPORTANCE OF THE EUPHRATES ROUTE TO INDIA.*

By MAJOR-GENERAL CHESNEY, R.A. D.C.L. and F.R.S.

LADIES AND GENTLEMEN,

I HOPE you will not be alarmed on looking at the formidable size of the sheet before you. An extensive line of country requires a good deal of paper, yet I fear that the fifteen feet by twelve Map before you will do but very imperfect justice to the illustration of the important, and, at this moment, the all-absorbing subject of our communication with India.

The Diagram before you, as you will at once perceive, extends from London to Delhi and Calcutta.

The blue line shows the existing railroad through Germany, and also that proposed to be laid down along the Euphrates, as well as some of the Indian lines.

The red lines are those of powerful steamers, to run at each end of the termini of the railways.

The small yellow lines are those of the electric telegraph, one going across Asia Minor to the Persian Gulf, and on to the Indus; a second from the Orontes also to the Indus; and a third passing down the Red Sea, and rounding Arabia to Kurrachee.

When all these shall be completed, passengers and mails—even with our present class of steamers—may be conveyed from London to Kurrachee in thirteen days and a half; and if by laying down electric wires we can, within the short space of eighteen or twenty hours, be assured of the welfare of some dear friend or relative who is in a distant part of India, two great objects will have been accomplished, which only a few years back, even the wonders of Aladdin's lamp, aided by the boldest and highest flights of fancy, could hardly have enabled us to imagine.

However, the fullest and most complete realization of these

* On account of the importance of this subject at the present time, the above lecture has been printed out of its order of date.

palpable advantages—which realization is probably close at hand—will be but a small part of the changes which must result therefrom. In fact, the construction of the intended railway is but *a part* of the question before us. It is far beyond any human power to foreshadow even faintly the changes which will follow the opening of a highway, and the annihilation of time and space, between the *East and the West*.

I cannot therefore expect or even hope to do anything like justice to the wide field which has fallen to my lot, of endeavouring to call your attention to the *political, military, commercial*, and, may I not add, the *social* importance of the Euphrates Valley route to India.

It is impossible to name this region of our globe without hosts of recollections of the past crowding upon our minds. To these, however, I shall but very briefly allude.

But we cannot name the Euphrates without remembering that we are there carried back to the earliest seat of mankind, to the *original spring* of *all* that has since flourished, and extended over our globe; in a word, to *Eden*, with its *rivers* which were “parted and became into four heads;” for the Hebrew equally bears the translation of a mass of waters. We see them now before us, and the very words of Moses describe them as truly now as they did when he wrote them.

The Halys, once the Pison, “compassing the whole land of Havilah, where there is gold, and bdellium (ascertained to be the pearl), and the onyx stone.”

The Gihon, “that compasseth the whole land of Ethiopia,” or Asiatic Cush, now the Arast, or Araxes, from Araxenes, son of Armenac.

The Hiddekel, or Tigris, so named from its well-known swiftness, and going as of old “towards the east of Assyria” and the Euphrates.

“And the fourth river is Euphrates,” as if this name expressing everything, required no description from the inspired historian. Those who have seen it can well understand this; the great and noble river, destined to become the highway of nations, of commerce, and renewed civilization to the countries it traverses and fertilises.

To the Arab, the word *Frat* still *says* everything, and *is* everything.

The sources of these four rivers are not far distant from each other, nor from Mount Ararat. Two of them still bear their Mosaic

names; and the fourth river washes the remains of antediluvian Sippara as well as those of Babylon—the Babel of the Arabs.

Near its banks are also the remains of the other three primeval cities of Erech, Akkad, and Kalneh.

It may seem strange to speak of the remains of an antediluvian city. But we know that Berossus places Sippara in Babylonia; and Captain Lynch ascertained that the Arabs still preserve the name of this city in their Sifera, as they have also retained those of Babel, Akkad, and Kalneh. And these antediluvian remains will seem less strange if we recollect that the Deluge does not appear to have effected any great physical changes in the earth's surface. We know from Scripture that the olive-trees remained standing, and that the vine brought forth her fruit almost immediately after the subsidence of the waters.

In connection with the Euphrates and Babylonia we have the dispersion of mankind, and the peopling of Arabia and Assyria. We have the first empire of history—that of Nimrud the Assyrian. We have the earliest astronomical observations, so long preserved in Babylon—all this before coming to the departure of Abraham from Haran into Syria and Arabia, where he already found a numerous population—a proof, if any were wanting, of how rapidly population has spread and increased in a country so calculated by climate and natural advantages to foster its progress.

Later, we are reminded of the consolidation of Media, Assyria, Babylonia, Syria, and Phœnicia, under Cyrus the Great; and still later we find ourselves going over the conquests of Xerxes, following the younger Cyrus in his passage of the Euphrates at Thapsacus, and then retracing the battle of Cunaxa, and the retreat of the Ten Thousand.

With the reign of Alexander, however, we come to the first historical connection between Europe and India by this route.

He first *showed* us the feasibility of marching a large army by the line of the Euphrates to India.

From Egypt, Alexander advanced on the Euphrates, and crossed it at Thapsacus, where it is now proposed that one of the railway bridges should cross the river; marched and fought at Arbela; took Babylon, Susa, and Persepolis, and subjected the whole of Persia.

He saw and showed its importance in his great military operations. He overran Parthia, Media, Bactria, and advanced to the borders of the Caspian.

He crossed the Oxus and Jaxartes, and wintered in Bokhara. Thence he invaded India. What he did, others may now do also; unless indeed we fail to profit by the lesson to be learnt from the campaigns of this great warrior.

On the revolt of his troops he descended the Hydaspes and Indus, and commenced his homeward march.

We must not forget the voyage of Nearchus; we have had pilots by sea as well as our great pioneer by land in the proposed line. He marched on through Gedrosia to Susiana, where he was joined by Nearchus; and then his comprehensive mind saw the advantages of opening a trade with India, of planting colonies, and building cities in these fertile regions; and he did both. We must now follow him to the Lamlum marshes of the Euphrates, which remain unchanged to this day. The steamers of the expedition of 1835-36 navigated them with difficulty; and ague and fever, such as that which cost Alexander his life, still prevail in their neighbourhood. But a canal cut through these marshes would change this part of the country entirely; and I proposed to effect this by some such means.

While we in the present day march with such difficulty, and with such loss of men and horses, we are startled to find on a careful calculation that Alexander's army marched during these conquests 19,020 miles.

We must, however, bear in mind that Asiatics are capable of bearing much more fatigue in this way than ourselves, and I have myself had proof of this in the Persian army, which I have known to march 40 miles a-day for several consecutive days.

After the death of Alexander Seleucus became possessed of Western Asia, and we will pass over more than two centuries to come to the invasion of Arabia by Crassus—51 years before Christ. The Romans had discovered, as we have now done, that "Europe is no longer the world; and that the true key to the possession of the world is the Valley of the Euphrates and Tigris."

With a view to its conquest, Trajan proceeded to the East. He wintered in Antioch, took Nisibis, Edessa, and Ptesiphon, and,

descending the Euphrates, he cut a canal between the rivers, called the Nahr-Malcha and took his ships along it, and then down the Tigris to the Persian Gulf.

Next in review we see Zenobia pass before us, defeated in the plains of Antioch, her cavalry struggling among thistles, which rose above their heads, as they still would do.

Palmyra falls; and an interval of ten years brings us to the invasion of Julian the Apostate, and his descent of the Euphrates. According to Gibbon, he constructed a fleet on the Khabour, consisting of fifty large vessels of war, and 600 boats of wood, and 500 of osier, covered with leather.

These boats, described by Herodotus, are still in use on the Euphrates.

On the 7th of April, A.D. 363, Julian encountered a most terrific hurricane on the river, at a spot answering to the present El Kaim above Anah; and it is remarkable that it was apparently nearly at the same spot that the expedition which I had the honour of commanding was visited by a similar and equally fearful hurricane, in May, 1836.

After the siege of Perisabour, we must follow Julian's fleet through the Nahr-Malcha, which he had previously cleared out, down the Tigris to Seleucia. Here he burnt his fleet, and commenced his retreat. His death followed. Jovian succeeded to the command, and crossed the Euphrates with great difficulty at Dura or Tekrit.

From this period, A.D. 363, we have no record of any great military expedition in connection with Western Asia until Napoleon conceived the idea, in 1809, of transporting a force down the Euphrates, with a view to the invasion of India. All his calculations and arrangements were made for this end. His troops were to have been transported on rafts constructed of timber cut down in the vicinity of the sea coast, and on the banks of the river.

With a little of his daring we might do the same at this moment, and with much greater facility.

The garrisons in the Mediterranean might readily spare 7,400 men; of these 2,400 might go through Egypt, and 5,000 could be conveyed to the mouth of the Orontes in a few days. They

would then have before them a march of 110 miles, with ample means of transport to the river.* Pontoons, native rafts, and boats would carry the force down to the Persian Gulf in less than fifteen days. There, native vessels could be found to transport them to Kurrachee by a safe and rapid navigation at this season.

A few words will suffice to explain my first connection with the Euphrates.

In 1830 the late Consul-General Cartwright placed some queries in my hands respecting the relative advantages of the Red Sea and Euphrates lines of communication with India, and I set out as a volunteer, to obtain the desired information.

On my return from the Egyptian and Red Sea survey in 1830, I reported to Sir Robert Gordon on the practicability of a line from Bombay through Egypt, and on the last day of the year I commenced my descent of the Euphrates on a native raft constructed of timber and hurdles supported on inflated skins, only attended by an interpreter, an Arab guide, and two boatmen.

I was soon saluted by shots from the Arabs, who watched my progress from the banks, and I had to raise a parapet of sacks for shelter. The rest of my voyage was more quiet. I sketched the river by my eye, laying down its course, taking the bearings by the compass, and the soundings by means of a pole sunk through the raft to the depth of ten feet. As long as it passed clear, I knew we had that depth of water; and, whenever it met with any obstruction, I noted the depth on my chart. I was obliged to resort to this expedient to avoid awakening the suspicions of my crew.

At night the raft was secured to one of the numerous islands of the Euphrates, and, with the first dawn, we resumed our primitive voyage.

In this way we arrived at the singular fountains of bitumen at Hit. Here my raft was exchanged for one of those boats which make us practically acquainted with the construction of the ark, being "coated within and without with pitch."

The banks of the river presented a succession of water-wheels for

* Sir John Macneill met 1,453 camels, horses, and mules in one day between Suedia and Antioch, and was assured that on an average 1,200 camels and horses pass the toll-bar of Jesr-Hadid on the Orontes daily, or 10,000 in a week.

the purpose of irrigation, aqueducts, and remains of dams, which only require to be repaired to renew the unexampled fertility of this country. We know from Herodotus that ancient Assyria surpassed all other countries in productiveness, and that this was owing to the admirable and complete system of irrigation practised by the people.

A flat country, abounding in date-trees—the fruit of which is so fine on the Euphrates as to form a very large article of commerce—continues as far as Felujah Castle, opposite to Baghdad, and a bare country follows until you reach the neighbourhood of Babylon, where there are some very productive farms; but the ruins of the city itself are totally uninhabited, excepting by the lion and the bittern.

Here I exchanged my native boat for a more commodious one belonging to the residency, and continued my navigation through the Lamlum Marshes. I sailed among the singular inhabitants of this part of the river, who are, I believe, of Persian origin. They live in neat mat huts in the midst of rice-fields, and use extremely pretty and very swift canoes to go from spot to spot for labour or occupation. Some distance below Lamlum is the Arab capital, Sheikh-el-Shuyak; it is a considerable place, some of whose inhabitants live in mat and others in brick-built houses. A flat country, with date-trees and cultivation, continues from thence to Kurnah, the proposed terminus of the line of railway, for which it is admirably adapted on account of the deep water, which enables large and heavily-laden vessels to discharge their cargoes at once on the *natural quays* with which it is provided.

At the time of my voyage the dikes intended to keep this part of the river within bounds were in good repair, but lately they have been neglected, and the water has, consequently, been allowed to overflow its banks during the high season; a little labour, however, would restore these dilapidations, and lessen, if not prevent, inundations.

At Kurnah we entered the Shatt-el-Arab, a noble stream formed by the junction of the Tigris and Euphrates. Forty miles lower, Bussorah is seen on the right bank, and twenty-two miles lower down is Mohammerah, on the left bank.

There is an almost continuous belt of rich-bearing date-trees from Sheikh-el-Shuyak to the sea, a distance of 169 miles.

This ended my river navigation of 689 miles. I continued my voyage to Bushire; travelled through Persia to Trebizonde, thence through Asia Minor to Scanderoon and Aleppo; examined the Upper Euphrates, and returned through Asia Minor to Constantinople.

The river Euphrates offers such varieties of scenery that it is difficult to do more than give a brief and general description of its banks. Its two great branches, the Kara-Su, or black water, and the Murad-Su, or river of desire, rise near Ararat, and continue their course—the former for 450 miles, the latter for 586 miles—through a mountainous country until their junction. The banks are generally bold, high, and precipitous; the bed usually uneven and rocky.

The principal caravan passage is at Bir. The river is 140 miles from the Mediterranean, and is 628 feet above the level of that sea, and, as it rises 1,117 miles from the Persian Gulf, the fall scarcely exceeds six inches per mile.

As you proceed onward, its swelling hills resemble those which occasionally enclose the Rhine. Afterwards, for a time, it may be compared to the Lower Danube, and then again we are reminded of the Nile,—with its date-trees, and Arab tents. Occasionally it also presents the remains of stone walls, aqueducts, and water-wheels. The Euphrates, however, has features peculiarly its own, caused by a mixture of nomadic and settled inhabitants with their tents and houses, and by its numerous islands, some wooded, others having small towns built with or amidst ancient remains, some of which, in the time of Trajan, must have been important places; such as Deir, Ana Tilbus, Hadisa, El Oos, &c. The riverain population is still, however, considerable, and there is, consequently, a disposition as well as an opening for trade.

From the moment that I embarked on this noble river, my whole mind was filled with the contemplation of its immense capabilities. It seemed to me to be intended by Providence to carry Christianity and civilisation on its waters—to be once more, as of old, the fertiliser of the splendid country through which it flows—to be the restorer of that ancient commerce which once flowed so freely from the East to the West—and which the West might so easily, and with such

profit to herself, conduct back into its early channels. My chief fear was lest I should be forestalled in pointing out this line to India, and the capabilities of the Euphrates for steam navigation. I never shall forget my feelings on seeing, as I thought, one day *the smoke of a steamer* in the distance ! It proved to be a flight of birds ; but, until I had made this welcome discovery, I thought I had been forestalled ; I little thought *then* that after *proving* the perfect navigability of the river by expeditions under myself and others, I should, after a lapse of more than twenty years, be still urging that this great undertaking should be carried out.

The result of my descent of the river was given in a report to Sir Robert Gordon and his successor Sir Stratford Canning. It was printed for private circulation in 1833, with a comparison of this and the Red Sea route.

His late Majesty William the Fourth at once commanded my attendance at St. James's, and after personally examining the maps, and perceiving that the Euphrates route had so little of open sea, he took up the question warmly, and continued to assist the cause most strenuously up to the time of his death.

The first great move was the appointment of a Committee of the House of Commons to examine the respective claims to support of the Red Sea and Euphrates questions ; and, with reference to having a second route to India, £20,000 were voted by Parliament for an expedition to the latter river. This, as you all know, it was my lot to command. On landing in Syria we met with every possible opposition from Mehemet Ali, who refused us means of transport from the coast to the river, and threw every impediment in our way. We, however, succeeded in carrying a line of levels from the sea to the river, having reference to a canal or railway for this portion of the route, and succeeded, after ten months of exertion, in carrying our two iron steamers piecemeal across the country for 145 miles. We put them together at Port William, just below Bir, and accomplished the survey of the Mesopotamian rivers as had been intended.

When we had achieved about the half of the descent of the river, the terrific hurricane to which I have already alluded, carried the smaller steamer, the Tigris, to the bottom. But the river Euphrates

is not in any way more answerable for a calamity of this kind, than are our own shores to occasional disastrous storms. Ammianus Marcellinus is our authority for the partial destruction of Julian's fleet during the descent of the river 1,473 years ago ; but neither history nor Arab tradition record any other instance of the sort. It is obvious, therefore, that we have little to fear, whether for navigation or for railway transit.

Soon after the return of the expedition three other river steamers were sent out, and the Euphrates was ascended, as far as Beles the port of Aleppo, by Captain Lynch and Commander Campbell of the Indian Navy, who afterwards descended the stream with the vessels. The pressure of the Afghan war caused their removal to the Indus, and as no steps have been since taken to replace them, either by Government or the East India Company, the navigation of the river has remained in abeyance.

There have been various proposals at different times for opening a communication with India by the Euphrates Valley. That which took the most practical shape was elaborated by Lieut. Campbell, then of the Royal Engineers, in 1843. His proposal and map were in all essential points identical with those more recently proposed by the great engineer Sir R. Macdonald Stephenson. These and many other subsequent proposals, both French and English, have all now become merged in the Company, of which Mr. Andrew is chairman, and Sir John McNeill the engineer in chief.

I was strongly pressed last year to join in the promotion of my favourite object of nearly a quarter of a century, and urged to proceed to Constantinople to obtain the necessary firman from the Sultan, and make all preliminary arrangements. Feeling that, with the prospect of a railway, a more careful examination of the country to be traversed was desirable, I was accompanied by Sir John McNeill, civil engineer, and two assistant engineers. We reached Constantinople by the route of the Danube, opened negotiations, and made all preliminary arrangements with the Turkish government, and then proceeded to Syria, in H.M.S. Stromboli, which was placed at our disposition by Lord Lyons in the kindest manner possible. Nothing could have been more fortunate for us, since she was commanded by an officer, Commander Burgess, who proved himself to

be one of those men who *seek opportunities* of doing good service to their country; and most warmly was he seconded by Mr. Albert, the master, as well as the rest of his officers and men.

We examined carefully the coast of Asia Minor where the Taurus touches the sea, in the hope of finding a practicable valley for a future line through that country. The harbour of Alexandretta did not promise to answer, and the ancient harbour of Seleucia was also condemned as not having sufficient depth of water; but, on the southern side of the Bay of Antioch, a suitable spot was selected by Sir John McNeill, admirably adapted to form a safe and commodious harbour of refuge, which will be capable of receiving second-rate line of battle ships, and will be as good as, or superior to, the harbour of Kingstown. The Turkish Government is to bear the expense, and has engaged to construct this great work simultaneously with the railway.

The spot chosen is three miles south of the river Orontes. The harbour is proposed to be formed by running out a breakwater on the south side of a small natural harbour, at about three miles south of the estuary of the Orontes, and six miles south-east of the old port of Seleucia, which is now silted up by sand. A small outlay would render the site chosen for the new harbour a perfectly safe and secure landing-place for boats, so that vessels taking out materials for the construction of the railway could, in the summer months, anchor in safety off this landing-place, where there is good holding-ground; and here the various materials and plant that would be required to enable a contractor to commence work on the railway, could be landed without the risk and inconvenience of sending the boats over the bar at the mouth of the Orontes, which at times has only three and a half feet of water, and often a heavy surf, even with light winds from the west or south-west.

The breakwater or pier is proposed to be formed by the stone which abounds close to the point where the pier or breakwater will abut on the land. The stone is of the finest quality, and can be quarried to any extent at a very moderate cost, and run by trucks on a tramway into the proper position. It is proposed to construct about 1000 feet in length as speedily as possible in the first instance, which will give shelter to three or four vessels at a time to lie close along

shore at the proposed landing wharf on the north-east side of the harbour, which will save the expense and inconvenience of landing from boats; this proposed shelter can be afforded in eighteen months or two years, and will enable vessels drawing twenty feet water to lie in safety during the winter months, if required to do so. The pier or breakwater should be subsequently carried out much further, and have a cant of 1000 feet trending towards the north-east, so as shelter the whole harbour from the westerly and north-westerly gales—in any other point it will be sheltered by the land.

The expense of this harbour, estimated at about £350,000, will be borne by the Turkish Government: they expressed themselves as most anxious to commence this work, and to carry it out under the direction of Sir J. McNeill.

The harbour when completed will be capable of giving shelter to thirty or thirty-five large vessels—the average depth of water will be from twenty to forty feet.

In six months from the commencement of the work, a landing-place can be formed, and perfect shelter for the boats, at an outlay of £20,000.

Our survey of the country and the subsequent trial sections of the engineers extended from the coast to within sight of the Euphrates, taking in the towns of Antioch and Aleppo. Beyond the latter *all* engineering difficulties cease—the country presenting a hard dry level surface, called in Arabic *Ká-jaledé*, or *flat and hard*, most admirably adapted for a railway; and even between the Mediterranean and Aleppo the difficulties are such as would be considered *small* in this country. There will not be a single tunnel, and only two cuttings of any consequence: two chain bridges over the Orontes will be necessary; but neither do these present any obstacles to engineering science of the present day. The average expense for the first part of this line, which will be the most expensive portion of the whole, is estimated at £13,484 per mile; and another portion, which also presents some difficulties, is £12,754 per mile; but as portions beyond Aleppo fall very considerably below this average, some of them being estimated at only £4,698 per mile, the average expense for the whole of this first section of the line from the

Harbour to the Euphrates has been calculated by Sir John McNeill at £8,858 per mile.

On my return to Constantinople the terms of the concessions were finally settled ; but, owing to opposition from rival parties, they were less favourable than had been previously arranged. The Turkish Government gave a guarantee of 6 per cent. on the capital expended by the Company, requiring from them a deposit of £28,000 in exchange for the firman, with the condition that the works must be commenced within one year.

The expense of the whole line is estimated at £6,000,000; but assistance from our own Government is asked in some shape on the first section only, or on a sum of £1,400,000, since the railway, after reaching Aleppo, will require no assistance whatever.

I found the Porte thoroughly alive to the great advantages likely to result to Turkey from the establishment of this line. The consolidation of the Sultan's power in distant provinces of his empire, the great extension of commerce to be expected, the centralization of the system of Government—these and many other considerations were strongly felt by the Turks.

We found, indeed, the existing commercial returns in Syria most satisfactory. Without taking into account *any* increase, Aleppo alone and her commerce would suffice to support a railway thus far, and would yield a return of 8 per cent. to the shareholders. 1,800 shares were at once taken in Aleppo itself; and a petition was sent to the Sultan in favour of the railway. To the eastward of this city, however, a *large additional* trade may be expected; indeed, a very extensive trade *exists*, which would all flow into this railway. We shall have Syria and Mesopotamia on one line, India and Central Asia beyond, with Kurdistan and Persia on one side, and Arabia on the other. It is impossible to estimate the amount of traffic and commerce which will arise—it *must* be very large—it may be beyond what even England has ever seen or imagined, for there is no limit to the productive powers of these countries, provided capital and skill be employed to turn to account the vast provision for their fertilization contained in their noble rivers. The chief products at present are grain, which could be supplied to Europe to any extent. Cotton of a very superior quality—this

is already cultivated largely, but not yet well-cleaned, in the neighbourhood of Mossul, and would be grown much more extensively if any means of transport existed. My friend Mr. Rassam, Her Majesty's consul at Mossul, tells me that 100,000 camel-loads of cotton are now lying there for want of means of transport. Wool also, copper, sugar, indigo, saltpetre, dyes of various kinds, bitumen, and various other products, are the present ordinary exports of Mesopotamia.

Their demand for our goods would be proportionately large. At present the natives of Syria and Mesopotamia receive many of their supplies from Russia through Trebizonde; but their markets would be supplied by Manchester, Sheffield, Birmingham, &c., if the means of transport were but established.

It is, indeed, impossible to estimate the changes in European countries by throwing open to them these sources of commerce and openings for colonisation; and may we not humbly hope that it may be vouchsafed to us to carry back to our eastern brethren *those truths* and *that teaching* which came to us from thence, and to which we owe all the blessings and happiness which make England what she is?

This railroad, if carried out, will pass through a country hallowed by recollections too sacred to speak of here, but which every one present must *feel* and understand.

I have dwelt at some length on the commercial advantages to be expected from this line; although at this moment *even these* must yield in importance to the all-engrossing desire for more rapid communication with India. This, and telegraphic wires in operation, would be worth anything to England at this moment.

In speaking of the advantages of this line in its military, political, and commercial bearings, I would ask you to observe, that, with the same kind of vessels and equal means of speed in both cases, the entrance of the Persian Gulf will be reached in one or two days less time than the entrance of the Red Sea at Bab-el-Mandeb. But the difference of open sea *onward* is very great. From the Red Sea to Kurrachee we have 1,864 English miles—whilst we have only 718 from the head of the Persian Gulf to the same port, or less than one-half. In the one case we have the monsoon right ahead

towards Aden, in the other it is nearly abeam to Ormuz. I need scarcely add, a difficult and dangerous navigation in the one case, and a perfectly safe one in the other. It was this great difference in the open-sea distance of the two lines which made so great an impression on his late Majesty. When looking at the map, he at once said: "I am a sailor, and can appreciate this great advantage;" and up to his lamented death he warmly supported the Euphrates route.

The means of rapid and certain transmission of mails and passengers to India ought alone to decide the public and Government in favour of this line. For the transport of troops and stores it would be of inestimable importance.

Few political objects perhaps could be of more consequence to England than those which will be so thoroughly accomplished by this line; I allude chiefly to the consolidation and to the commercial and political resuscitation of Turkey. We have expended lavishly money and lives, ostensibly for this object, but without any benefit to ourselves, and without imparting any real *strength* to Turkey. By this line, however, we *secure* the defence of her frontier against Persia and Russia. You have already seen what a powerful influence has belonged at all times to the possession of the Valley of the Euphrates. A friend, who is intimately acquainted with the East, writes to me: "I was in those countries during the Russian war, and frequently thought how different the position of that power would then have been if their army had been moved in the direction of the Euphrates valley, instead of invading the Principalities and European Turkey. Europe would have remained in a state of apathy, and public opinion, *out of England at any rate*, would have been for them. Had they reached Mossul under these circumstances they would have been in a country whose resources surpass almost any other in the world."

This, or a very similar, plan was proposed to the Emperor Nicholas by one of his generals during the war of 1828-29. We may be thankful that it was not adopted.

Dr. Sprenger says: "If properly managed, the Valley of the Tigris would soon be sufficiently prosperous to form the basis of a campaign to the south-east, or the same route that was taken by the

Arabs when they conquered the Valley of the Indus in the seventh century of our era.

“The straits of Ormuz are so narrow that the Persian Gulf might at any time be converted into a lake belonging to the power which may be in possession of Bussorah. *Europe is no longer the world; and the true key to the possession of the world is the Valley of the Tigris*, and not Constantinople, as it was believed in ancient times.”

These are a few, and still but a few, of the great results likely to arise from the establishment of this line of communication. The subject is one of too great magnitude to be embraced in a lecture; but I trust I have said enough to give you an interest in its progress and success, and I will only add a few words on the subject of the *Arabs*, whose very name seems to inspire dread in many minds, and who are constantly represented as being hostile to the proposed railway.

The Arabs are a very singular, a very peculiar people. I have lived among them for many years—I have experienced their extremes of good and bad—the greatest fidelity to their engagements—the greatest truthfulness—the greatest hospitality and kindness from them in some instances, while in others I have been robbed by them. I have twice been led out to be shot by them—I was saved almost by a miracle, and yet these very Arabs lent me money when they released me, to pursue my journey, on the faith of my English word and name.

At one time during the Euphrates expedition, Mehemet Ali had set a price on my head—still not an Arab took measures to secure this reward, although “Chesney Beg,” as they called me, was more than once in their power.

Our chief difficulties with the Arabs would arise from their ignorance, the divided and sometimes hostile state of the tribes, their blood feuds, and their occasional breach of faith. Of this I myself experienced an instance, for, instead of performing their promise of taking me round the Dead Sea, they carried me and my party off into the Desert, robbed us, and kept us some time for a ransom. Notwithstanding this, the journey was in many respects a very interesting one, and we escaped at last by disarming one of them, when they were in reduced numbers, and recovered our money.

The story is too long to tell, but it was stated at Damascus that this *mistake* arose from there being no one at that time to keep the Beni Sakka tribe in order.

On the other hand, I must observe that such a breach of faith is the exception to what I have usually met with from this people. During the Euphrates expedition their caravans carried for us large stores of muskets, powder, and ammunition, as well as considerable sums of money, to the amount of £6,000 or £7,000, attended only by one individual of our party, and in no one instance was there *any* loss to us. These undertakings were usually paid in advance; and, when the Arabs were prevented from fulfilling their engagements, the money paid was scrupulously returned to us. It is a startling fact, that neither during the expedition I commanded, nor those which followed, which occupied several years, did we lose a single man by the Arabs.

They are, indeed, as much alive to their own interests as other nations, and will soon appreciate the advantages which they will derive from the railroad by regular employment of themselves and their camels, and increased trade. If, however, they should show hostility contrary to all expectation, such arrangements have been made with the Sultan's Government as will meet even this difficulty. It must be remembered also that a body of workmen such as we must employ, amounting to 10,000 or 12,000, are already a considerable defensive element; and we should also recollect that Ibrahim Pasha kept the Arabs under perfect control.

In addition, however, to my own opinion, I will read to you that of a friend, Dr. Aloys Sprenger, the first orientalist of the day, and who has resided for *many* years among them. His description of the Arabs is too good to be omitted.

"Some time back I received a letter from Mr. Porter, at Damascus, expressing great uneasiness on account of the Bedouin, but nothing can be more unfounded than this cause of alarm, for the Bedouin are the most manageable people in the world if judiciously treated. But, even if matters were to be mismanaged as they have been at Aden, and the Bedouin should offer every opposition in their power, it would be of little avail. It would soon be found that, notwithstanding their personal bravery and cunning, they are

very much like wild beasts ; no one has ever heard of an army of tigers, and so it would be with the Bedouin, who have never been united. Like wild beasts they would show desperate courage when irritated ; but such ferocity can do nothing against discipline and calm resistance. As a proof of this, I may mention that there are some Kurdish villages below Mardin, in the midst of the desert which, small as they are, defy all the power of the Shammar tribe, and successfully refuse to be taxed. Whoever possesses the Euphrates has the Bedouin in his pocket, for this cuts them off, and they cannot do without its water, and other resources. Those who really entertain fears of the Arabs forget that a railway running through a fertile country is a vein of life. In less than ten years we shall see towns and villages springing up on both sides of the line, and thousands of these nomades settled in them.

“N.B.—It has been arranged that the Sultan is to give the necessary protection if the Arabs do not further the railway of themselves.”

In confirmation of the opinion here given of the manageableness of the Arabs, I may mention that by means of a marriage, and by giving, myself, a small portion to the bride, at the same time reminding them that the Koran inculcated peace, I settled a blood feud of long standing between two hostile tribes.

It is, however, on a gradual operation that I build for bringing all things right, and for this reason I took no part in the proposal for laying down the electric wires through Arabia at present. From the difficulties to which I have alluded in dealing with the Arabs, you will easily understand that I considered isolated wires passing through their country as very insecure. I however thought it right to open negotiations at Constantinople on this subject, and I also arranged with Mr. Barker, Her Majesty's Vice-Consul at Aleppo, who has passed his life in that country, that he should, if required, go among the Arabs to make preliminary arrangements for the establishment of the telegraph, by opening, in the first instance, the line of Tartar posts which were in use in Lord Wallesey's time.

The principal points of this question are now before you. Each individual will form his own opinion as to the desirability and practicability of carrying a railway and electric wires through

Arabia. I assume the affirmative in both cases, and if I were twenty, or even ten, years younger, I should be very happy to prove on the spot that I am right. But I feel that at my time of life I should be doing mischief to a great cause; and surely this ought not to be the case when my place can be supplied by an officer of great perseverance and singular uprightness (provided he would undertake the charge). I allude to Capt. Charlewood, R.N. This officer is in the prime of life, understands the management of railways, and not only has had great experience of the Arabs, but he knows the country, and also practically what is necessary to carry out the navigation of the river Euphrates.

I have now only to add that I hope I have not trespassed at too great length on your time, and that you will henceforth feel some little interest in the progress and success of the Euphrates Valley Communication with India.

Evening Meeting.

Monday, June 15th, 1857.

Colonel the Hon. JAMES LINDSAY in the Chair.

NEW MEMBERS.

The Chairman announced that 18 new Members had joined the Institution since the last Meeting, viz. :—

LIFE MEMBERS.

Earle, William, Capt. Gren. Gds. Foster, T., Col. Royal Engineers.

ANNUAL SUBSCRIBERS.

Earlsfort, Lord, Lieut. 1st Life Guards	Nicholl, Hume, Lieut. 7th Drg. Gds.
Hayter, Arthur D., Lieut. Gren. Gds.	Echalaz, R. C., Cornet 7th Drg. Gds.
Foster, B. L., Lieut. Royal Artillery.	Ferguson, G. A., Capt. Gren. Gds.
Brown, H. Newton, Capt. 2nd West York Light Infantry Militia.	Douglas, John, C.B., Lieut.-Col. 79th Highlanders.
Aldred, John Wm., Lieut.-Gen.	Clerk, A., Capt. Royal Artillery.
Griffin, J. H., Col. Royal Artillery	Dacres, Sir R. J., K.C.B., Maj.-Gen. Royal Artillery.
Moore, Jno. Croft, Lieut. Rifle Brigade	Ellis, W. B. E., Lieut. Royal Artillery
Dowdeswell, W. F. Lieut. 7th Dragoon Guards.	Cameron, John, Capt. Royal Engineers.

INCREASED SUBSCRIPTION.

The under-mentioned Officer had raised his Subscription from Ten Shillings to One Sovereign since the last Meeting :—

Dacres, Sir R. J., K.C.B., Major-Gen. Royal Artillery.

DONATIONS.

List of Donations from 1st to 15th June.

To the Library.

Papers on Subjects connected with the Duties of the Corps of Royal Engineers.
New Series, Vol. VI. Presented by the Editors.

ON THE MOLECULAR CONSTITUTION OF THE METALS
OF ORDNANCE, AS AFFECTING ITS CONSTRUCTION
AND ITS WEAR IN SERVICE.

BY ROBERT MALLET, Esq., C.E., F.R.S., &c.

WITHIN the limits of a single Lecture it will not be possible to do more than glance at some leading characteristics of a large and important subject, the complete treatment of which requires more than one volume, and which, old as is the art of gun-founding, remains yet in great part to be written. I shall confine myself at present, amongst the metals which may be viewed as peculiarly those formative of artillery, namely, cast iron, wrought iron, steel, and bronze, to the three first, reserving for perhaps some future occasion any remarks upon the last, the most compound and complex, and, though the oldest used, perhaps still the least understood material of ordnance. And again, in the remarks I purpose making upon iron in its three remarkable states—cast, wrought, and steel—as materials for ordnance, I propose restricting myself to some views as to the molecular constitution of these metals :—

- 1st. As influencing the proper form of cast-iron guns ;
- 2nd. As determining the proper construction of guns of wrought-iron ;
- 3rd. As affecting the wear and tear of guns in service—in explanation of the hitherto misunderstood phenomena called “ drooping at the muzzle.”

Incidentally, a few remarks may occur with reference to steel and bronze.

I speak in presence of many who upon the well-fought field, or before the shattered tower, must have had frequent opportunities of observing guns burst in service, and who will have probably remarked a certain general uniformity of direction in the fractures—a common method, as it were, according to which a gun (if sound) always bursts—but probably also without having attempted either to analyse the conditions upon which uniformity under such apparently accidental and capricious circumstances rests, or to follow out to their consequences, as regards the gun itself, the law of such conditions

when ascertained. I propose, in the first place, briefly to trace both of these.

The Plate No. 1 shews by the heavy dotted lines the almost invariable directions in which fracture takes place when cast-iron guns burst in proof or in service. Assuming no serious flaw or other defect to exist anywhere, the gun splits up nearly into equal halves, usually by a vertical or nearly vertical plane, passing through the axis of the piece, and extending from the breech-ring, which it often also divides, longitudinally to a point a little in advance of the trunnions, where it turns out to one side and to the other, leaving the muzzle portion of the gun for a length of between two-fifths and one-third its whole length unbroken. This portion of the gun at the moment of fracture is thrown forwards, partly by the direct action of the powder-blast escaping, partly through the unbalanced action of the elastic forces within the strained metal suddenly released, and partly by the friction of the passing-through shot. It usually falls to the ground with the muzzle end foremost, and as this strikes the ground the mass throws a somersault, and is found lying along in the line in which the gun had been trained, but with the direction of the muzzle reversed, or pointing backwards, a circumstance often remarked upon with surprise by artillery officers, but which is thus easily accounted for.

Sometimes the portions of the gun at and in rear of the trunnions are divided by other fractures in planes more or less completely at right angles to the preceding one, and by several "turn out" or transverse fractures. These latter occur and are more numerous in proportion as the metal of the gun is harder, more highly elastic, and more rigid, and as the bursting charge is more powerful—in a word, the fragments are smaller and more numerous, and more irregular, when the rending forces are greatly in excess of the resisting powers of the metal.

The fractures of bronze guns are of a somewhat different character, and the fragments are bent and distorted, both owing to the greater toughness and ductility of the material.

Three circumstances are specially worthy of attention as indicated by the lines of fracture thus generally described ;

1st. The dividing longitudinal plane, whether vertical or hori-

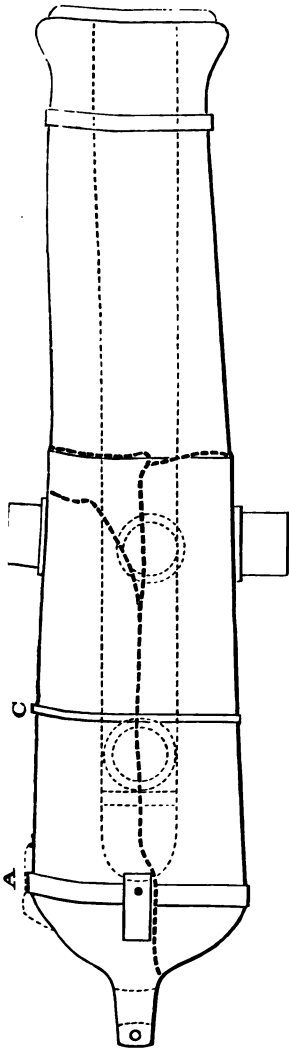


Fig. 1.

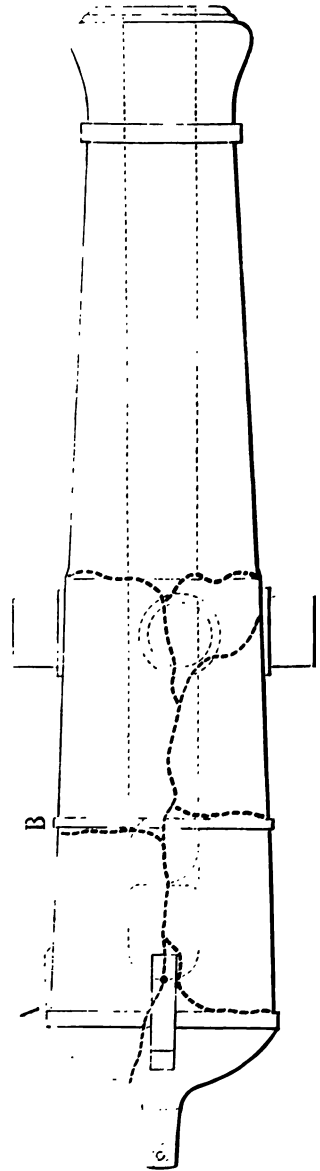
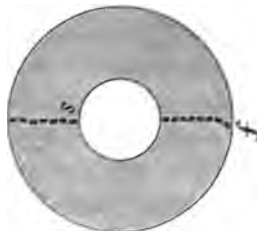
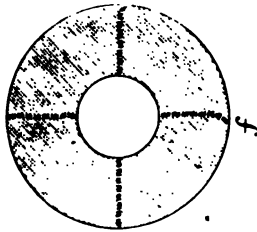
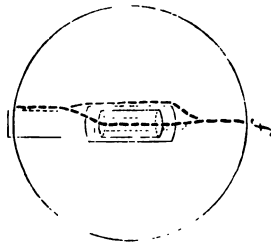


Fig. 3.



zontal, is always found to assume a sudden curved form, as in diagram, at one or other side of the exterior of the gun; indicating that the fracture begins at one side s , that opposite to the inflected fracture, and that fracture has spread from that side, the gun opening out and the divided surfaces turning from each other upon the point of inflection at e as the hinge.

2nd. Fracture therefore appears in all cases to commence at the interior of the chase, and to propagate itself outwards, thus rending the metal from within to without; a result which, though difficult at first to reconcile to the imagination, is pointed to by every mathematical investigation of the resistance of cylinders to internal fluid or elastic pressure—leading to whatever formula—since *the metal must yield first when the pressure per square inch is greatest upon its resisting unit of section, and this is in the interior of the thickness.*

3rd. The planes of fracture follow the track, with almost unerring precision, of all re-entering angles, and of all sudden changes of scantling or dimension, however trifling, in the external contour of the gun. Thus a vertical longitudinal fracture often passes through the vent (as being the weakest part in section), but much more frequently follows along the re-entering angle made along the exterior of the gun at its meeting with one or other side of the vent field, as in fig. 1 and fig. 3. The transverse fractures, though often more or less diagonal to the axis of the gun, also mainly follow round, with remarkable regularity, the small re-entering angles made by the several breach or reinforce mouldings on the exterior of the gun, while those which approach the trunnions usually fall into the re-entering angles made by these with the body of the piece.

No doubt these facts are familiar to every one who hears me, but I am not aware that the value of their correct observation has hitherto been recognised, or that any attempt has been made to assign a cause for them, or, in fact, to attribute the directions into which a burst gun breaks to anything more than "accident."

I proceed to explain the cause. It is a law (though not noticed,

so far as I know, by writers on physics,) of the molecular aggregation of crystalline solids, that when their crystals arrange themselves under the influence of heat in motion, these arrange and group themselves with their principal or long axes in lines perpendicular to the cooling or heating surfaces of the solid, that is, in the lines of direction of the motion of the heat, and this is true whether in the case of heat *passing from* a previously fused solid in the act of cooling and crystallizing on consolidation, or of a solid not having a crystalline structure, but capable of assuming one upon its temperature being sufficiently raised by heat applied to its external surfaces, and so *passing into* it.

For example, if an ingot of sulphur, antimony, bismuth, zinc, hard white cast iron, or other crystallizable metal or atomic alloy, or even any binary or other compound salt, or haloid body, as sulphuret of antimony, calomel, sal ammoniac, various salts of barytes, and lime, chloride of silver or of lead, chromate of lead, or even organic bodies, such as camphor and spermaceti, provided only they be capable of aggregating in a crystalline form under the influence of change of temperature, as from fusion or sublimation—if an ingot or mass of any such body be broken, the principal axes of the crystals will always be found arranged in lines perpendicular to the bounding planes of the mass, that is to say, in the lines of direction in which the wave of heat has passed outwards from the mass in the act of consolidation.

But, conversely, the same effect is found to be produced by the application of heat (far below that of fusion) to the surfaces of solids, which are capable of solidification in either of the two states, homogeneous (amorphous) or crystalline. Of such bodies many are known. For example—many of the metals, glass, carbon in certain states, ice, chalk, when crystallizing into marble under pressure and ignition, oxide (litharge), and iodide of lead; and amongst even organic bodies—sugar, paraffino, spermaceti, &c.

If a cylinder of lead of some four or five inches long, and about the same in diameter, be cast around a round bar of iron of about $1\frac{1}{2}$ inches diameter, and some two or three feet long, the lead on becoming cold, and rapidly consolidated by the contact of the cold iron bar interiorly, will have a perfectly homogeneous structure; it may be cut into, beaten out, &c., but presents no trace of crystallization.

If, however, one of the projecting extremities of the iron central bar be now placed in a furnace and heated red-hot, and time be given until the heat conducted along the bar, and from it passed into the interior parts of the lead cylinder, and thence transmitted outward radially through the latter in all directions, shall have raised the temperature of the lead itself to within a few degrees of its melting point, say to about 550° Fah., and the lead be now struck sharply with a hammer, the whole mass will be found to have assumed internally a crystalline structure; all the principal axes of the long thin crystals radiating regularly outwards from the axis of the cylinder to its surface, and by a few blows of the hammer the whole mass will separate and fall to pieces as a metallic dust; so complete are the planes of separation of the crystals. (See Plate II. fig. A.)

A piece of cylindrical brass wire, tough, fibrous, and presenting no traces of crystallization, may in the same way be caused to become almost instantly brittle and crystalline, if passed endways into the centre of a red-hot iron tube of small diameter (such as a gun barrel), held vertically.

A flat plate of thick rolled or malleable zinc, which is nearly homogeneous in structure, or, if not so, presents fibres and lamina in the plane of the plate, if laid down flat upon a cast-iron plate, and heated to within a few degrees of its melting point, assumes very soon a crystalline structure, the crystals having their principal axes now all cutting perpendicularly through the plate from side to side; in other words, the internal structure being in this and the former case absolutely turned round 90° of angular direction.

The same change of structure takes place more slowly in glass: when exposed for a considerable time to a heat short of fusion, or even complete softening, it is converted into the opaque substance known as Reaumur's porcelain, in which a crystalline structure is developed, and the principal axes are arranged perpendicular to the surfaces recipient of the heat.

Many other instances might be adduced, were this the place to pursue so tempting a subject; but enough has been given to indicate the generality of the law.

Now cast iron is one of those crystallizing bodies which, in con-

solidating, obeys, more or less perfectly, according to the conditions, this law also; so that generally it may be enunciated as a fact, that *in castings of iron the planes of crystallization group themselves perpendicularly to the surfaces of external contour; that is to say, in the directions in which the heat of the fluid cast iron has passed outwards from the body in cooling and solidifying.*

Because the crystals of cast iron are usually small, and are never very well pronounced, these directions are seldom very apparent to the eye, but they are not the less real.

Their development depends—

- 1°. Upon the character of the cast iron itself; whether it contain a large quantity of chemically uncombined or suspended graphite or not, which Karsten has shown to be the case with all cast irons that present a coarse, large-grained, sub-crystalline, dark graphitic or shining spangled fracture;—such irons form, in castings of given size, the largest crystals.
- 2°. Upon the size or mass of the casting, the largest castings presenting, for any given variety of cast iron, the largest and coarsest aggregation of crystals, but by no means the most regular arrangement of them, which depends chiefly upon—
- 3°. The rate at which the mass of the casting has cooled, and the regularity with which heat has been carried off, by conduction from its surfaces to those of the mould adjacent to them; and hence it is, that of all castings in iron those called “chilled,” that is to say, those in which the fluid iron is cast into a nearly cold and very thick mould of cast iron, whose high conducting power rapidly carries off the heat, present the most complete and perfect development of the crystalline structure, perpendicular to the chilled surface of the casting. In such the crystals are often found penetrating $1\frac{1}{2}$ inch or more into the substance of the metal, clear and well defined.

These prevailing directions of crystalline arrangement may be made more clear to the eye by the Plate II. No. 2.

Figs. 1 and 2 are sections of a rotund and a square bar of any of the crystalline solids we have spoken of, or of cast iron when

FIG. 1.



FIG. 2.



FIG. 3.



FIG. 4.



FIG. 5.



FIG. 6 B



FIG. 6.



FIG. 9.



FIG. 7.



FIG. 8.





the crystallization is well developed (the circumstances affecting which we shall consider further on). In the round bar the crystals all radiate from the centre; in the square bar they are arranged perpendicularly to the four sides, and hence have four lines (in the diagonals of the square), in which the terminal planes of the crystals abut or interlock, and about which the crystallization is always confused and irregular.

In fig. 8 a flat plate is shown in section. The directions of the crystalline axes follow the law of No. 2, with an expansion in one direction.

In fig. 4 a section is shown of the hollow cylinder of lead alluded to (ante, page 170), in which, as in the case of fig. 1, the arrangement of the crystals is always towards the centre or axis of the cylinder. This figure also applies to every cast iron hollow cylinder, whether water-pipe, gun, mortar, &c.

Fig. 5 represents a portion of the lower or closed end of the cylinder of the hydraulic press as first made for the purpose of raising the tubes of the Britannia Bridge, and which broke in the attempt; the end of the cylinder having broken out from the sides, in the form of a fracture of a cone, as in fig. 5 B, under the severe water pressure to which it was exposed; that is to say, the fracture took place all round, along the plane of junction of the conterminous crystals, formed perpendicular to the external and internal surfaces of the bottom and of the sides of the cylinder, proving that such planes of junction existed as in figs. 2 and 3. The crystals here join and interlace confusedly; these are *planes of weakness*—planes in which the cohesion of the metal is less, and for this reason, than in any other parts of the mass. These *lines of weakness* extend from V to V throughout all the figures. The form of the bottom of this cylinder was changed by Mr. Stephenson, from a distinct appreciation of the fact, that the fracture of the first was in some way connected with the sharp and sudden termination square to the axis of the cylinder, though without apparently any clear conception of the crystalline laws upon which the fact depended, and a new cylinder, with a sort of hemispherical end, was made, a section of a portion of which is represented in fig. 6. This stood the strain uninjured. Here the principal axes of the crystals all are directed, as in figs. 1 and 4, to

the centre. They therefore *gradually* change their direction, and no planes of weakness are produced.

It is to be hoped that these illustrations have served to make clear the general law as applied to cast iron artillery, that *every abrupt change in the form of the exterior, every salient, and every re-entering angle, no matter how small, upon the exterior of the gun or mortar, is attended with an equally sudden change in the arrangement of the crystals of the metal, and that every such change is accompanied with one or more planes of weakness in the mass.*

Figs. 7 and 8 are sections of portions of a large cast iron gun. The former one of part of the breech through the "vent field" square to the axis of the bore. The latter, a section near a trunnion, also square to the axis. Fig. 9, a section of a reinforce ring in the plane of the axis. In all of these are shown, in an exaggerated form, the directions of crystalline aggregation, and the planes of weakness resulting from it.

It will be remarked that the square projection of the "vent field" produces at each salient and re-entering angle planes of weakness, which in the case of the latter angles penetrate deep into the thickness of the gun: and that these planes really do exist, is evidenced by referring back to Plate No. I. in which it will be seen that the lines of fracture in burst guns almost always follow along the angle at the sides of the "vent field."

So also in the case of the trunnions (fig. 8). On referring back to the same diagram, it will be seen that the great planes of cross fracture usually turn out and meet the exterior of the gun just at the re-entering angle of the trunnion with the body of the gun. A gun, like every other body that fails under strain, must fail in the weakest place. We have shown in what places they do fail, and we have shown, *à priori*, what must be the weakest planes (for a given material and mass), and we have found that the places of fracture and positions of these "planes of weakness" most remarkably coincide. The conclusion therefore seems inevitable, that, however incapable the unaided eye may be to discern any difference in the crystalline arrangement of one part of the gun more than of another, such planes of weakness do exist, in the positions and from the causes here pointed out.

The external forms of cannon have been greatly modified and simplified of late years from the complex and highly ornamented (?) forms of former periods ; but even still, in the plainest forms of guns, such as Sir William Congreve's patterns, Monk's, &c. mouldings, astragals, reinforces, &c. are still adhered to, and, from unwillingness to give up altogether, antiquated forms, adopted and continued in ignorance, we have the folly still to cling to making numerous sharp angles and corners, and sudden changes of form and of dimensions, on the exterior of all our ordnance, and so prolong, in the most needless way, one cause of their weakness. That gun, however plain externally, will look best to the really educated eye that most fully conforms to the laws upon which its perfection as an instrument depends.

Some remarks should now be added as to the effects upon the strength of guns which circumstances, brought into play in the processes of moulding and casting them, exercise, extraneous to those which we have already treated of as respects the directions of aggregation of the crystals of the metal.

Although not my intention to go at all into questions referring properly to the iron-founder's art, to practical methods, better or worse, or to the details upon which sound or defective castings depend, as these, though most important, do not find a fitting place here, it would yet be desirable to consider,—

1. Upon what circumstances the more or less complete homogeneity of the crystalline alloy we call cast iron depends when cast into guns, and therefore how, with the best or with any external form, we may most avoid the formation of “planes of weakness,” so far as the moulding and casting are concerned;
 2. The effects due to the contraction of the metal in process of cooling, and of sudden changes of mass or of dimension upon this;
 3. The effects of rapid and of slow cooling, and of unequal cooling;
 4. The effects of casting under the fluid pressure due to increased “head” of molten metal;
- and to add a few remarks upon the presumed relative advantages so

much and so loosely talked of latterly; of cold-blast and hot-blast iron, and of foreign and British iron, as materials for ordnance; these, however, I must pass in a very cursory manner. It is known to every practical iron-founder upon a large scale that generally the larger the mass of the casting he makes with any given quality of cast iron the "*coarser is the grain*," that is, the larger are the crystals that develop themselves in the mass. The same metal that shall produce a fracture bright gray, matted, and without a crystal visible even to a single lens, when cast into a bar say two inches diameter; shall, if cast into a cylinder of two feet in diameter, produce a dark confusedly crystalline surface of fracture as coarse as granite rock.

To meet this, the practice is to prescribe for material for large castings a certain large proportion or mixture of "small close-grained scrap metal" with the pig iron, of whatever quality may be directed. The remedy fails, as fail that always must which is founded upon a misconception of the laws of the phenomena. As well might small seeds be sown to produce small trees. The small scrap is no sooner cast into the large mass than it assumes the large crystalline grain. Again, by some iron-founders one "make" or sort of pig-iron is presumed to give a closer grain than another, and he prefers it; and although this is to a certain extent true, *i. e.* that some cast irons—that is, some of the innumerable alloys that go under that name—do, under equal conditions, produce rather smaller crystals than others, still this view equally fails to attain the object of *close-grained heavy* castings. But, furthermore, it is a fact familiar to iron founders, that of several castings of the same form and mass, made at nearly the same time from the same mixture of metal, and melted in the same furnace, some will when cold have a much more coarsely crystalline grain developed in them than others. The fact is familiar, but I am not aware that any attempt has been made on principle to explain it, and hence no means taken to prevent its occurrence.

Now while the *regularity of development* of the crystals in cast iron depends as we have already seen upon the regularity with which the melted mass cools, and the wave of heat is transmitted from its interior to its surfaces, arranging the crystals in the *lines of least pressure* in its transit, the *extent of development*, or, what is the same

thing, the size of each individual crystal, depends upon the length of time during which the process of crystalline arrangement is going on, that is to say, upon the length of time that the casting takes to cool. Hence then it may be announced as a law, that

The size of crystals, or coarseness of grain, in castings of iron, depends, for any given make of iron and given mass of casting, upon—

1st. The high temperature of the fluid iron above that just necessary to its fusion;

2nd. Upon the time that the molten mass takes to cool down and assume again the solid state.

The conclusion and rule that I deduce from a wide and careful consideration of all the conditions affecting the formation by casting of cast-iron guns is, that

The lower the temperature at which the fluid cast iron is poured into the mould, and the more rapidly the mass can be cooled down to solidification, the closer will be the grain of the metal, the smaller its crystals, the fewer and less injurious the "planes of weakness," and, *cæteris paribus*, the greater the specific gravity of the casting;

in fact, the better the gun, from whatever sort of cast iron it may have been formed.

I have shewn, too, by experiments made upon a very large scale, the results of which may be found in the Transactions of the British Association for 1840, and also in my work on the Construction of Artillery (1856), the important effects producible by casting under a great head of liquid metal, an increase of density of metal under a head of 14 feet = about 44·8lbs. pressure per square inch being obtained (with some makes of iron) in the ratio of 7·1035 : 6·9551.

Some experiments made in the United States upon this point have led to indecisive results, but only because the head of metal tried (amounting to but a few inches) was too insignificant to yield any clear indication.

It has been proposed also in America, in order to obviate some of the evils of unequal cooling, in large guns during consolidation, to cast them hollow and cool, from the interior as well as exterior—by passing through the former a cooling current either of air or even of water.

The method has nominally been prescribed for the conduct of some of their government contracts for guns; but I have reason to believe that practically the device has been abandoned, and that, as most founders would have foreseen, the plan is too far removed from easy control, and too liable to produce evils greater than those it was intended to remedy, to be of any service. In fact, a cast-iron gun cooled down too fast from the interior will be in a far worse condition to resist the strains of service than one that has cooled from the exterior surface only.

Practical iron-founders are in the habit of judging of what they deem by experience the best temperature of the fluid iron for being poured into the mould, by a certain peculiarity in the form of the vorticose movements that go on upon the surface of a mass of fluid iron, and called technically "the breaking" of the iron. This test, however, is perfectly empirical and fallacious; the very lowest temperature at which the iron remains liquid enough fully to fill every cavity of the mould without risk of defect, is that at which a large casting, such as a heavy gun, ought to be poured. As respects the rapidity of cooling desirable, we shall be enabled presently to consider the conditions that determine the extent to which it may be safely carried.

A certain amount of contraction on becoming solid from the liquid state occurs in all castings. It is well known to practical founders that for cast iron this is variable, and depends upon the mass of the casting, being greatest for small, and least for large castings; but it is obvious, and it follows, from M. Bolley's researches, that the contraction also will be greater in proportion as the metal is poured into the mould at a higher temperature, although, from the expansion in the act of crystallising, the specific gravity of the solid mass may be less at the higher than at the lower temperature of "pouring."

As therefore there are two conditions that principally affect the degree of contraction, the total change of volume between the liquid metal and its solid casting, namely, the extent to which the fluid metal as entering the mould has been expanded by elevation of temperature, and the state of final aggregation of the crystalline particles, which we have seen depend much upon the former, so

there will be a determinate amount of contraction due to a determinate thickness or mass of casting, irrespective of, though also related to, the co-efficient of contraction for any particular "make" of iron; for there is no doubt that different makes, *cæteris paribus*, contract somewhat differently. From whence it follows that different parts of the same casting, if differing materially in scantling or mass, will have different amounts of final contraction; and hence—

Sudden changes of form or of dimensions in the parts of cast iron guns, besides the injury they do to the crystalline structure of the mass, introduce violent strains, due to the unequal contraction of the adjoining parts, whose final contraction has been different.

How desirable is it, therefore, to introduce such changes into the forms of our ordnance as shall avoid those sudden and enormous (and often useless) changes of adjacent mass that we observe; as, for example, in the sea and land service, 13-inch mortars, where at the chamber the thickness of metal (where the strain is least) is nearly double that of the chase, and suddenly becomes so; a malconstruction, the full evils of which we have not now time to consider.

The amount of *lineal* contraction due to solidification of cast iron appears to vary with metal and circumstances of casting from $\frac{1}{125}$ up to $\frac{1}{50}$ of the dimensions of the cold mass. Its contraction in volume therefore (more than three times this, and probably not equal in the directions of three rectangular axes) is so great, and the difference such between its measure for large and small parts of the same casting, that its effects never should be neglected.

Its effects are well known to founders in causing castings of certain forms to become distorted, or spontaneously broken, after they have solidified. To multiply instances would be tedious, but one circumstance requires remark, as proving that these internal strains, occurring in castings of variable bulk, exist when little suspected, and that it is with extreme slowness that the molecules, after consolidation, appears gradually to assume changes of minute arrangement, and to adjust themselves within certain limits to a state of permanent equilibrium.

It is a fact known well to practical mechanics engaged in boring or turning, or otherwise cutting into large castings of iron that have

cooled safely and without crack or flaw, that yet, when a part of the whole mass shall have been cut away, as for example, when a large and thick-flanged cylinder, or a large-toothed wheel or other irregular discoid mass, is "bored out," the form of the exterior of the mass changes during the operation. The portion cut away destroys the temporary equilibrium that was established in the mass, and it again changes its form and perhaps its symmetry. For some most valuable illustrations of the singular forms or lines of direction which the curves of internal tension and compression take in solids of various forms thus under elastic constraint, Mr. Maxwell's paper, Trans. Royal Society, Edin. vol. xx. part I. may be consulted.

They bear a remarkable analogy to the nodal lines traced by the researches of Chladni and Savart in the vibrations of sonorous plates, and directly are connected with the optical properties first shown by Sir David Brewster in glass under constraining forces.

Sometimes a casting which has cooled safely will fly to pieces on receiving a sudden jar or blow of a trifling degree of force. A fact which is in analogy with that observed by Captain Parry in his earlier Arctic voyages, viz., that the astronomical instruments exposed to extremely low temperature for long periods and quite undisturbed, did not contract to their extreme points until after they had been subjected to some slight jar or blow, when the metal of the instrument *suddenly* became reduced in volume and its dimensions again stationary.

The extreme slowness with which these molecular changes take place, due to the gradual adjustment of such internal strains, has been beautifully shown by M. Savart, in a memoir on the Elastic Properties of Solids (*Annales de Chemie*, vol. xli. p. 61). He found that plates of sulphur cast into flat discs continued to change their state of molecular arrangement for long periods after solidification.

It follows from this that old guns that have long been bored and laid in store are likely to be more trustworthy than those hastily cast, bored out, and brought into service, and this seems to be supported by experience in some degree.

Let us now proceed to apply to *wrought iron* the law of molecular constitution already viewed in reference to cast iron; and then

briefly to draw one or two conclusions as to the proper methods of construction of wrought-iron guns.

When wrought iron in any of the usual forms of its manufacture is fractured, its molecular structure presents itself, more or less distinctly pronounced, in one or other of three forms:

- 1°. Its mass consists of minute crystals of nearly uniform size, whose facets present themselves at all possible angles, like that of refined sugar. This "saccaroid" structure usually belongs to the most highly refined iron, and often to hard steely irons, such as those of Sweden. The larger bars of Low Moor iron present perhaps the finest examples of this structure.
- 2°. The surface of fracture consists of large, sometimes very large, lamellar spangles or plates, the facets of crystalline cleavage, whose directions tend to coincidence generally with the surfaces of fracture. The number, size, and directions of these facets varies in the same mass with the directions of fracture. This is the structure of all large and heavy forgings or of *large* rolled bars. This and the former structure are often found irregularly united in the same surface of fracture in ill-manufactured iron, and is the usual one presented by common small bar iron.
- 3°. The fracture (hard to produce, owing to the greater flexibility of the iron than in either of the preceding cases) when effected, presents long parallel fibres, or bacillary crystals, running in the direction of the largest dimension of the bar. This is the structure of the best and toughest iron, such as that for making chains and rivets, good boiler plates, &c. It is found partially combined with the 1st and 2nd in some inferior irons.

We found in cast iron that the law of arrangement of its crystals is to place themselves perpendicularly to the surfaces of the mass. In wrought iron the tendency is, upon the whole, to place themselves parallel to the principal surfaces. It would seem, therefore, at first, that the law of aggregation, apparently so opposite, must depend upon totally different conditions; they are, however, essentially the same. *In wrought as in cast iron, the principal axes of the crystals*

tend to assume the directions of least pressure throughout the mass, while exposed to pressure and heat in progress of manufacture.

Let us take the most strictly normal structure, the 3rd; for example, a round bar of rivet iron half an inch in diameter. This has been formed by the pressure of the grooved rollers in directions transverse to the axis of the cylinder, pressing it smaller and smaller, and still elongating it from a short thick mass, whose original structure, if broken, may have been that of 1 or 2. The metal being rolled at a temperature at which it is as soft as lead at ordinary temperatures, heat is evolving the whole time, as in the case of cast iron in cooling; but the pressures introduced within the mass are of a different character, and arise from a different cause. In cast iron they arose from the contractions of the mass in cooling. In the wrought iron bar (relatively small in two of its dimensions, and therefore little affected at all by contraction in cooling), the internal pressures are produced by the rollers; but their pressures are all in directions perpendicular to the length of the bar, or, in our round bar, in the directions of the radii of the cylinder. The direction of least pressure is therefore coincident with the length of the bar, and this is the direction in which the principal axes of the crystals arrange themselves. The same is the case with iron drawn into wire, where the directions of maximum pressure being manifestly in the plane of the "drawplate," the aperture in which presses powerfully round the periphery of the solid passing through it, that of least pressure is, as before, parallel to the length of the wire, and so are the fibres or crystals arranged.

Heat, as increasing malleability and ductility, facilitates the arrangement; but as iron is a ductile substance even when cold, so heat is not essential to the molecular change in the arrangement of its particles; just as in cast iron we saw that molecular transpositions may continue long after the mass has become solid.

This is as strictly in analogy with the observable facts of crystallization in other bodies, whether simple or compound, ductile or rigid, passing through an intermediate plastic state, or crystallizing *per saltum*, which crystallizes in bacilliary or fasciculated crystals, as were the analogies we found in the case of cast iron. Thus, for example, arragonite, tourmaline, gypsum, actinolite, manganese,

alum (from Cape Coast Castle), amianthus, &c. &c., are all frequently found in embedded (more or less rounded) fasciculi, of long parallel fibrous crystals. When these are examined carefully with a lens, the external crystals are always found more or less deformed by the pressure of the external embedding matrix, to which they are moulded, although not formed by infiltration and gradual filling of a mould. In every such case there are accompanying evidences of great pressure in directions perpendicular to the longer dimensions of the bacillary mass. Thus nearly cylindric pencils of arragonite are found so formed in the intensely compressed chalk, overflowed by huge incumbent caps of basalt in the North of Ireland. Similar pencils are found, though not cylindric, of tourmaline, in granite, manganese alum, and fibrous gypsum, in enormously deep beds of clays, which, when soft and plastic, transmitted the pressure of their own mass of hundreds of feet in depth, with the fidelity almost of a fluid. Again, amianthus in serpentine, whose configurations prove the former play of enormous pressures, through plastic masses since become solid and rigid; and instances might be greatly multiplied.

Two of the examples given—arragonite and gypsum—present the remarkable identity, that they are found in both of two conditions, viz. in the arrangement of the crystals of cast-iron, with their principal axes perpendicular to the bounding planes, and parallel to them as now indicated for wrought iron; in each case the arrangement having followed the lines of least pressure, howsoever produced, provided it were coincident in time with such other conditions, whether of ductility, plasticity, fusion, or liquidity by solution, as admitted of molecular transfer and re-arrangement.

Returning now to the wrought-iron rolled bar, while its diameter continues small or moderate, although, in the progress of its cooling, internal strains and variable pressures are induced by contraction,—still, as almost all appreciable contraction is confined to the one direction of the bar's length, so these new internal pressures are inoperative in producing any distinct changes in the disposition given to the (fibre or) crystals in rolling. Not so, however, if the diameter of the bar, in place of being small, be very large in proportion to its length, and its mass great in proportion to the pressure brought upon it by the rollers. The operation of rolling is then less

effective in the first instance to induce a general and uniform parallel arrangement in length of the principal axes of the crystals; some remain in other directions to the bar's length: the bar, however, is now let to cool; fresh internal pressures become developed by contraction within its mass; the cooling goes on much more slowly, for the mass is much greater, in proportion to its surface, than in the long slender bar; and hence there is time for the new play of forces to act in re-arranging the crystals; the heat is carried off most rapidly from the greatest surfaces of the solid—but these are the sides of the bar. The contraction is greatest in the direction of its length; the maximum pressure due to contraction, therefore, coincides with the length of the bar; and more or less of the crystals arrange themselves now *transverse* to the length of the bar, in the directions of least pressure.

Whether the crystals of iron expand and contract by change of temperature alike in all axes is not known as yet; if not, and that the principal axes are those of greatest expansion and contraction, then, as the longitudinal contraction of the whole bar is proportionally greater than that in either of its other dimensions, so the previous longitudinal arrangement of the crystals, in so far as rolling has been operative in producing it, now increases the tendency to the secondary rearrangement of the crystals transverse to their former position. The small slender bar cooled almost instantly, and at once fixed the crystals and the longitudinal position they had assumed—length of time in cooling admits of the rearrangement in the heavy thick bar—aided by the softened condition of the mass as it passes gradually from a yellow heat to coldness.

Thus then as the mass—the relation of this to form and hence to surface—and of all, to the pressures transmitted to the iron in rolling, and to those induced subsequently by contraction in cooling, are varied, so will the main directions of crystalline arrangement be varied also; the variation may be either total and complete, as in the case of the slender bar, or partial and imperfect as in the grosser bar. But the evidences of ANY arrangement must depend upon the extent to which the individual crystals in any particular “make” of wrought iron are susceptible of development; in the case of *very* highly-refined iron (in the language of the iron-master “over-wrought” iron, in which

there has been no "cinder" left), with all its carbon perfectly combined, and thus approaching to steel, the crystals are so minute, often so perfectly microscopic, that in large bars no other than the uniform "saccharoid" structure is discernible, though the fibrous becomes perfectly developed in any small ones. This is the case with the fine Low Moor iron, which in rolled bars of 2 inches diameter and upwards presents a fracture almost identical with that of cast steel, but in rivet-rods a fine fibrous one.

I have used the term "fibre" as being already long in use, and conveying well to the eye the character of this particular form of crystallisation. But it should be clearly understood that the "fibre" of the toughest and best iron is nothing more than the *crystalline arrangement* of inorganic matter, and that the false analogies continually used, in which such fibre is spoken of and reasoned upon as identical with that of organic bodies, such as wood, hemp, &c. have no reality or basis in nature, and only tend to mislead.

The principles upon which the developement in size of individual crystal depends, however, will be best understood when we have considered some of the effects on wrought iron of forging into great masses.

In *rolled* bars, which we have so far alone treated of, the pressure of the rolls, unaccompanied by impact, though conveyed only to the one point of the bar at a time, is in succession and with great uniformity of direction applied to every part of it; moreover, the intensity of the pressure upon the unit of surface, or in relation to the section of the bar, steadily increases as the latter diminishes in size at each successive passage through the rolls.

A very different set of conditions occurs, however, in a *forged* bar or mass. The whole of the pressures now are impacts suddenly applied to local points of the surface, and thereby unequally transmitted through the ductile or partially ductile heated metal to its interior. The pressure at the surface due to any blow measured in the time of the hammer's descent through the space through which the surface before the blow has descended, is rapidly lost in transmission within the mass, by inertia, and by the corpuscular forces of whatever sort that the substance of the heated iron opposes to change of form. Blow follows blow in continually changing directions; and

on various portions of the mass. The directions of maximum pressure within it as constantly change as do the intensity of these pressures, not only in depth, but as transferred from point to point struck; the elasticity of the metal (though no doubt of a different sort from its elasticity when cold and more perfectly a solid) still exists, but in the various parts of the mass kept during the hammering, and perhaps for long after, in a state of instability. The lines of least pressure, therefore, are constantly changing under all these varying causes, and with them the directions of the principal axes of the crystals become changed and changed again—perturbed, broken, and confused; and if the mass be sufficiently large, when cold, and after its forging has been completed, its fracture, however fine and good the wrought iron, presents nothing but a confused mass of small crystalline facets differing scarcely at all from the appearance of cast iron in moderately large castings.

Yet no change other than that of molecular arrangement has necessarily occurred in the large mass, for it is a fact that such a confusedly crystallised mass may be built and “faggoted up” from small rolled bars, each of which is previously perfectly and uniformly fibrous, that they lose their fibrous structure and assume the confusedly crystalline one in the process of being united by forging into one large mass, and that a portion broken or cut off from the mass may be again rolled down into small bars, which shall be as fibrous in structure as at first.

The developement in size of crystal varies with the particular sort of iron. It appears to be largest and most lamellar (in large masses) in the most highly refined iron, and which contains an unusual dose of silicium; but the relations of size of crystal to chemical constitution require much further examination. With the same iron and same volume of forging, however, the size of crystal appears to be developed larger, in proportion to the time that the mass is maintained hot and in process of forging. This time is necessarily greater as the mass is so, and as the operations of reducing it to required form are more complex or laborious. In fact, as in cast iron we saw that the crystals were larger the longer the mass required to cool, so in wrought iron they are larger the longer it is kept hot. And thus it happens that in very large and

massive forgings, requiring often to be maintained at temperatures varying from a welding heat down to dull redness perhaps for weeks, crystals are developed within the mass of a size materially to diminish the cohesion of the iron in some places where flat planes of crystalline cleavage produce partial "planes of weakness." The size of these crystals is occasionally surprising, the broadest and flattest planes of cleavage frequently running in the directions in which surfaces of the integral "slabs" or portions of iron of which the mass has been formed have been welded together. The author has observed crystals so posited presenting flat planes as large as the surface of a half-crown piece.

The elasticity of wrought iron is greatest in the direction of the principal crystalline axis. Some experiments of Mr. Fairbairn's on the relative ultimate resistance to rupture of boiler-plates, when strained in the direction of their fibre, *i.e.* in the direction in which they were rolled, and transversely to the same, have induced him to come to the conclusion that there is little, if any, difference in either direction. If the iron of the plates be so very harsh, rigid, and bad of quality, as to have *no* (fibre) longitudinal crystalline arrangement, but approach nearly to that of a slab of cast iron, this may perhaps be nearly true, but in plates or bars of good quality it is certainly erroneous. The very few experiments upon which Mr. Fairbairn's conclusion rests will not even warrant it, if *one* result, contrary to all the others, and so exceptional as to suggest the probability of an error, be abstracted from the average deduced from the remaining ones; and it seems wholly disproved by the experiments of Mr. Edwin Clarke (*Britannia Bridge*, vol. i. p. 377), who found that bars cut longitudinally and transversely from the same plate of fine fibrous iron of excellent quality, were broken by strains per square inch of section of—

		Tons.	Tons.
In the direction of the fibre	. . .	19.66	to 20.2
Across the fibre	. . .	16.93	to 16.7

and that *the ultimate extension of the plate in the line of the fibre was double as great as transverse to it.*

Taking the means of these experiments then at 20 tons longi-

tudinal, and 17 tons transverse, the value of the coefficient T_r * in each case will be—

In the line of fibre	.	.	.	.	=	234.84
Across the fibre	.	.	.	.	=	30.47

Taking the total extension .0016 in the first, and half that in the second.

We find, therefore, that the elastic range of wrought iron of any given quality depends upon the direction of the crystalline axes in relation to the strain, and that the elasticity is a maximum in the direction of the principal axis of the crystals, or line of fibre; and the important deduction arises from the above, that, for artillery purposes, the ultimate strength of a gun, in which the explosive strains are all resisted by wrought iron acting in the line of fibre, is to that of one acting transversely to the same, as 234.84 is to 30.47, or about as $7\frac{1}{3}$ to 1. This ratio expresses in fact the relative strengths of a "twist barrel" and of a common "skelp-welded" or longitudinally welded one; but almost the whole advantage of this is lost in massive forgings.

We have found that the effect of large increase in the mass of wrought iron is to prevent any regular or uniform arrangement of its integral crystals by the process of manufacture. That as such masses are necessarily continued long heated while forging, and occupy long in cooling, and contract considerably in all their dimensions in cooling, so the crystals are developed to a large size, and become arranged to a greater or less extent in directions transverse to the surfaces of contour of the mass. The results are irregular "planes of weakness," reduction of ultimate strength to resist a quietly and steadily applied tensile force of from 20 to 17, and reduction of resisting power to such impulsive forces as are concerned with artillery, in the ratio of from $7\frac{1}{3}$ to 1, or probably even more; for a train of difficulties is introduced in the manufacture, and of injuries done to the chemical qualities of the material, in a rapidly increasing proportion as we continue to increase the magnitude of the mass to be forged.

When the mass exceeds a very limited bulk (in breadth and

* Poncelet's coefficient of "vis viva of rupture."

thickness) the processes of rolling, &c. are at an end. Those of forging by the tilt or steam hammer alone are available; skilled labour, and all the mishaps to which the results of the most adroit workmanship are exposed in dealing with the heating and hammering of vast and scarce manageable masses, are inevitable. The mass must be gradually built up and aggrandized in size, by continual welding on to it of small pieces, involving reiterated heating and partial cooling, exposure for weeks perhaps to a temperature at which the exterior of the mass gets changed more or less in chemical constitution, and at each welding the risk of inclusion of more or less slag, cinder, or other foreign matter. At every additional piece thus laid on by welding, an additional doubt is produced as to whether or not the weld be sound throughout; no examination at the time can with certainty decide this: the mass however grows continually in bulk and weight, the inertia of the hammer (large and powerful as this has become through the intervention of the direct action of steam) becomes reduced in relation to that of the mass in the same ratio, the blow no longer acts with uniformity upon the mass submitted to it, but is confined in immediate effect nearly to the point struck. The mass, if very large, and especially if also long, can no longer be all maintained hot, but the jar and shattering vibration of every blow, as it thunders down upon the huge piece, continues to be transferred to the crystalline particles of the colder or quite cold portions, and probably produces at length some considerable alteration of molecular arrangement, in deterioration of strength.

At length the limit is reached when with our present known modes of working wrought iron (even with the heaviest and best appliances) we can no longer add to its size. The limit is reached by the power of heating the mass, or a certain required part of it, to the welding heat. The time required for the piece to remain in the furnace to effect this continually increases as its bulk grows, and with it the sources through which heat is lost and dissipated; but a certain proportion of iron is burnt away or melted off from the surface at the part requiring to be brought to welding heat and from adjacent portions at every moment that it remains in the furnace; at last as much in weight is burnt off or lost at each welding as equals the weight of the "slab" or mass laid on, and the labour is

then in vain. The work, like the embroidery of Penelope, becomes an endless task, and the limit has been reached beyond which the piece can be forged no bigger.

This limit can be stretched a good deal by the extreme skill of the operative forgerman and by the skilful construction of his furnace; but, however great these may be, this limit is at length reached by all, and with our existing tools in Great Britain is probably reached in every case at a diameter (of a cylindrical mass) of about four feet and about twenty feet in length.*

To the unpractised observer, who looks at one of these ponderous masses withdrawn from the furnace glowing like a sun, and observes the apparently little effect upon it that the thundering blows dealt by the steam-hammer produce, it always seems that nothing more is demanded than great increase of weight and length of stroke, or increased power in the hammer. This however is a mistake; good forging in heavy masses depends not so much upon the force of the blow as upon its exact direction, and its application at the precise moment when the welding metal is fit to receive it. The only effect of great increase in the power and especially in the velocity of the blow is to shatter and dislocate the internal or adjacent portions of the mass which are at or about, a low (cherry) red heat, at which temperature the best wrought iron appears to lose much of its plasticity of heat, and be comparatively crumbling and brittle. In fact, with existing hammers of five tons weight and six foot blow, this effect is actually produced very frequently.

Another and very different cause of unsoundness in very large forgings of great diameter I have recently observed the conditions of with care and explained elsewhere. It arises from the fact that in the slow cooling of such a mass the exterior becomes cold and rigid while the interior is still soft and even above a red heat. When finally the latter cools to the point of rigidity violent cross strains, owing to complex play of contractile forces (which time forbids my

* I am aware that these "difficulties of heavy forging," though undeniable, are attempted to be made very light of by a recent writer of one of the articles on "The Useful Metals" in Orr's Circle of the Sciences. The able and intelligent manager of the Mersey Steel and Iron Company's forge will, I trust, pardon my saying that his opinion cannot be considered unbiassed upon such a subject.

here entering upon), are produced, and the interior of the mass tears itself asunder, irregularly, but in a general plane passing through the axis and parallel to it, if it be a cylinder or prism, and reaching across about half its diameter. This defect is not visible until the mass be cut transversely. This is the main cause of the almost constant want of soundness in nearly all large forgings.

If we are to look for future great extensions of our power of producing vast masses of malleable iron (for whatever purposes) that shall give greater assurance of internal soundness, and preserve in the large, all the qualities of uniform and determinate disposition of fibre—in a word, all the valuable qualities of the best wrought iron as now known in small bars, it must be by some great extensions or modifications of the rolling process, accompanied by such improvements in the furnaces and modes of heating as will enable the largest masses of prismatic form to be produced out of more slender rolled bars laid together and heated, and at one welding operation rolled together (or otherwise pressed at successive points) into one gigantic bar, which for artillery might be then twisted by suitable machinery, such as that patented by Melling. To the subsequent operations of bending, cutting, or shaping such prismatic masses however, so as to fit them on a larger scale for the many general purposes to which forged pieces, or “uses” as they are called, are now applied, narrow limits of practical disadvantage and difficulty can be foreseen; and as regards the fabrication of artillery it scarcely admits of doubt that the limit of useful size has been already far surpassed, and that it is to a skilful and judicious combination of parts, each formed of malleable iron of moderate and manageable dimensions, rather than to forging in one huge piece, that we should look for the production of guns of the largest class in this material.

Those who desire to enter upon the consideration of the best modes of attempting this, I must refer to the pages of my own work upon the construction of artillery, as well as to those of others who have proposed various constructions of compound or built-up guns. The subject is too large, and involves too many dynamic questions of an abstruse character, besides those physical ones of which we have been treating, to be entered upon now.

I cannot leave the subject of molecular constitution in wrought

iron however, without explaining one most interesting case in which the law of aggregation before enunciated, throws a flood of light upon a hitherto ill-understood and obscure class of phenomena; namely, upon *the change of crystalline axis in wrought iron cold*—that is to say, at ordinary temperatures; that change by which, without sensible heating or cooling, without fusion or change of external appearance, and often with little change of form or volume, a piece of wrought iron, before tough, flexible, and “fibrous,” may be made to become instantly harsh, rigid, crystalline in fracture, and brittle. This is the change by which it has been *assumed* that railway axles, shafts, chain-cables, &c., and other articles of tough fibrous iron, grow brittle and faithless while in use.

Much has been loosely written of late years on this supposed “loss of fibre” and change to a confusedly crystalline structure in wrought iron, by the mere effects of long-continued jarring or vibration, or of very slight bending to and fro at ordinary temperatures; many affirming stoutly the fact, but without bringing forward any instance that amounts to proof; and others denying it, asserting in explanation, that in the instances adduced the “crystalline iron was never fibrous,” and which is probably the fact in most of the cases adduced.

The subject is one still requiring, for its being fully understood, a very careful and difficult research, and one worthy of being at once made. The following conclusions may however be provisionally offered, as probably not very incorrect:—

1°. There seems no reason to believe that any extensions or compressions, and therefore any flexures, however long continued or often repeated, produce any molecular change whatever in wrought iron; provided that—

a. The range of extension or compression be *far within* the elastic limits.

b. That the velocity with which the extension or compression is made be not extremely great, *i. e.* not beyond the “pulse period,” due to the elasticity of the material.

2°. Nor any reason to suppose that jarring or vibration, if unaccompanied by permanent change of form in the mass, is capable of effecting any molecular change whatever, provided that the material shall have been previously in a state

of molecular repose, *i.e.* free from internal strains due to form, contraction on cooling, &c.

Nor is it probable that abrasion, such as the grinding away of the bearings of railway axles, or the scoring and rifling of the chase of a wrought-iron gun by the passage of the shot, produces any molecular change; but—

3°. It does appear certain, from many well-observed phenomena, that instantaneous changes of molecular structure, and reversals or transpositions of the crystalline axes, can be produced in wrought iron at ordinary temperature, by the violent application of mechanical force, producing change of form at one or more points of the surface of the mass, if the directions of the force and the extent of change of form be such as to produce internal strains and inequalities of pressure, and that the extent of these latter is greater than the resistance in any one direction, due to the elasticity and range of the material.

It would be foreign to our subject to pursue this here at any great length, however interesting and important, and with one familiar instance we must dismiss it.

The well-known operation by which a blacksmith “breaks cold, over his anvil,” a bar of the toughest iron that can be had, consists in “nicking” one or both opposite sides of the bar at the required point of its length, to a *very small* depth, with a chisel having an edge formed to a very obtuse angle generally about 90°, and driven into the substance of the bar by blows from a sledge with great velocity. When this is done, a bar of moderate size, tough, fibrous, and at every other place capable of being bent sharply double without fracture, may be broken across at the “nicked” place often by bending over one’s knee, but always by a few light blows transversely on the anvil.

When the fracture is exposed, it is found at the “nick” to be short and crystalline; the crystals are, on the whole, arranged transversely at this point to the bar’s length; their facets are largest and most transverse, just at the bottom of the angle of the nick; and either no sign of the fibre constituting the structure of every other part of the bar is visible, or occasionally some portion of the section at the side or part most remote from the nick is still visible.

Now what happens here is rendered obvious by the diagram in Plate III., in which fig. 1 represents the side of such a bar at the "nicked" place, and the change of direction there of the crystalline axes. But what internal forces have acted on them? Looking at fig. 2, it will be seen that driving into the substance of the bar the edge of the wedge-shaped chisel, has produced compressions; but the pressures are propagated in directions perpendicular to the faces of the wedge, or of the nick that is the express copy of it. These pressures in the directions ab , $a'b'$, are resisted and finally equilibrated by the elastic compression of the crystals in the directions of their principal axes (mainly) cb , $c'b'$, and the resultants of these mutual pressures meet in the substance of the bar, in the directions bn , $b'm$, which are those of maximum internal strain; therefore in the space between these, and approaching the angle of the nick, and perpendicular to the resultants, are the lines of minimum pressure. Now these are the new directions that the principal axes of the crystals assume at the moment that these pressures disturb their previous equilibrium; that is to say, at the moment of making the nick.

Fig. 3 shews the further change in crystalline arrangement assumed by the bar, after that above described as due to the "nick," and which is produced by the subsequent bending prior to final fracture.

Supposing the bar bent by pressure or blows towards the side remote from the nick, as soon as the fracture is complete it presents a surface as in fig. 5, consisting of faceted crystals piercing the bar transversely from the angle of the nick to a certain depth—a central portion where the original longitudinal fibre of the bar has remained unchanged but is broken across—and again a narrow strip of flat faceted crystals at the side furthest from the nick transverse to the line of fibre. Now these latter were produced by the bending of the bar after the nick had produced the former. The side furthest from the nick is the *compressed* side of the bar, the neutral line being somewhere between. *The direction of least pressure* at this compressed side is therefore *transverse to the length of the bar*, and hence the new direction taken up by the crystals here in accordance with the general law. Had the bar been bent towards the side nicked in place of the opposite way, the nicked side would have been the compressed side, where the transverse crystals were already formed, and the fracture when

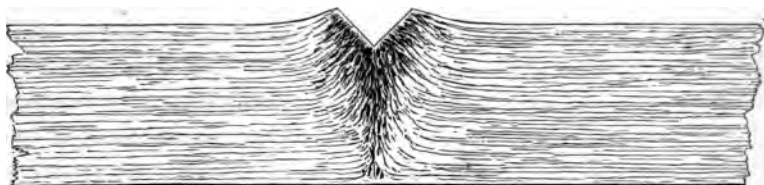
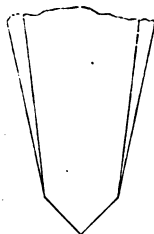


Fig. 1.

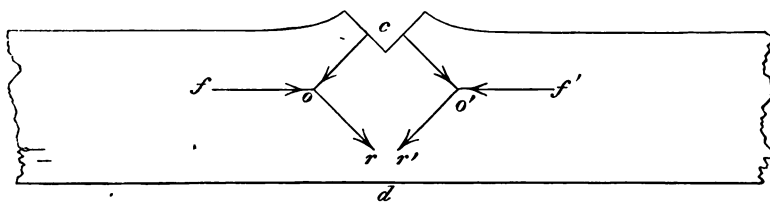


Fig. 2.

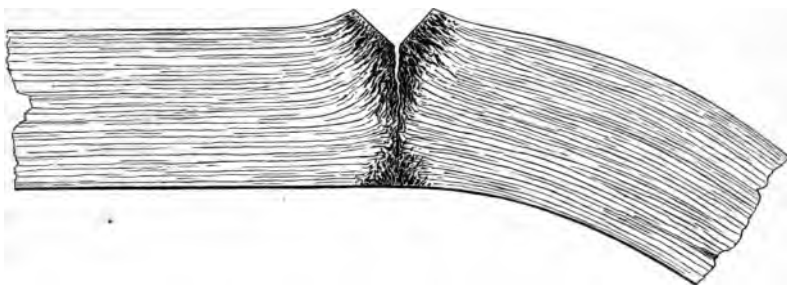


Fig. 3.

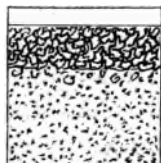


Fig. 4.

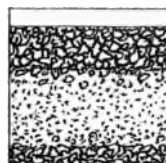


Fig. 5.

CHANGE OF STRUCTURE IN WROUGHT IRON, COLD.

broken across would have been fibrous out to the very edge remote from the nick (provided the whole bar had been uniformly fibrous beforehand), as shewn in fig. 4.

Thus then this change of crystalline arrangement is only another case of our general crystalline law—that the principal axes are found in the directions of least pressure within the mass, and that the change of direction possible to be produced in “cold iron” is due to the fact of its having more or less ductility at all temperatures, which means, in fact, that more or less permanent displacement of molecules is possible in the material at any temperature.

There is therefore no ground for assuming that wrought iron artillery would rapidly or at all (if originally properly proportioned) deteriorate in tenacity, and so gradually and yet unascertainably become unsafe in service.

Mr. Nasmyth, Mr. Hood, and Mr. Thorneycroft have written on this subject; the latter has collected some interesting facts, though some seem rather warped by preconceived views. In no paper, however, that the author has seen is any attempt made to connect all the phenomena of change of crystalline structure in iron at all temperatures with the action of some one recognisable force, such as that which the author believes to constitute the true solution and key to all the varied and complex cases noticeable, and which he has been the first to enunciate, namely, *the assumption by the principal axes of the crystals of the lines of minimum pressure within the mass.*

In concluding this second head of the three into which I have divided the subject of my lecture this evening, I would wish to be understood, that I do not advocate the indiscriminate adoption of built-up guns of wrought iron, nor even the indiscriminate use of wrought-iron guns at all. I do consider, and my conclusion has been come to after a lengthened and careful investigation of the subject, and the endeavour to apprehend and attach due weight to the purely military aspects of the matter and the opinions of artillery officers, that the adoption of wrought iron as a material for field artillery would be attended with the most important results. Some of these, chiefly those relating to financial economy, durability, and the facility and economy of transport in service, may be learned by an inspection of the following tables, in which the results of much

patient research are condensed, and which appear to me conclusive in support of the value of wrought iron for this particular arm.

Wrought-iron field-guns, however, are readily within our grasp to form, soundly, simply, and with cheapness, by methods which I have elsewhere pointed out, in one piece, up to 18 or perhaps even to 24 pounders at least; and as assuredly the rifle principle will ere very long be successfully applied to field artillery (and so its pre-dominance over the rifled musket again asserted), so it is not likely that larger calibres than these, if even so large, will be ever demanded for field-service.

TABLE I.

Of the Physical Properties of the principal Materials of Construction for Artillery, from British Data.

1	2	3 4		5 6		7	8	9
No.	MATERIAL.	Ultimate Resistance to		Immediate Resistance within Elastic Limit		Mean Extension per ton per square inch within	Mean Compression per ton per square inch within	Final Extension at the Elastic Limit
		Tension.	Compression.	Tension.	Compression.	Limit of Col. 5 in terms of L .	Limit of Col. 6 in terms of L .	In terms of L .
		Tons.	Tons.	Tons.	Tons.			
1	Gun-Metal . .	16	12 ?	4.5	3 ?	.000230	?	.00104
2	Cast-Iron . .	10	45	4.0	20 ?	.000230	.00018	.00088
3	Wrought-Iron .	27	16	12.0	12	.000100	.00010	.00120
4	Steel	49	60 ?	16.0	17.5 ?	.0000475	?	.00060

		10	11	12 13		14 15		16
No.	MATERIAL.	Modulus of Elasticity.	Modulus of Elasticity	Coefficient of resistance $\frac{1}{E}$ vis à vis of Elastic Resistance		Coefficient of resistance $\frac{1}{E}$ vis à vis of Rupture $\frac{1}{T_r}$		Modulus of Force Transmission.
		L_e	In Pounds per square inch.	Tension.	Compression.	Tension.	Compression.	Feet per second.
		Feet.	Lbs.	Dynams.	Dynams.	Dynams.	Dynams.	Feet.
1	Gun-Metal . .	2,790,000	9,873,000	5.24	?	65.94	?	8260
2	Cast-Iron . .	5,750,000	18,400,000	3.94	80.64	24.64	110.88	11100
3	Wrought-Iron .	7,550,000	24,920,000	16.13	16.13	81.64	48.40	12083
4	Steel	8,530,000	29,000,000	10.75	?	92.55	113.33	14108

NOTE.—The moduli of Elasticity are Tredgold's. The values of $\frac{1}{E}$, from the means of various experimenters, as also the values of columns 8, 4, 5, and 6.

TABLE II.

Comparison of Weight, Strength, Extensibility, and Stiffness; Cast-Iron being unity, within practical limits, to Static Forces only.

Material.	Weight for = volume.	Strength.	Extensibility.	Stiffness.	Torsion.
Cast-Iron . . .	1.00	1.00	1.00	1.00	Resistance. 1.00
Gun-Metal . . .	1.18	0.65	1.27	0.53	0.55
Wrought-Iron . .	1.07	3.00	0.45	2.20	1.11
Steel	1.07	4.75	0.32	3.15	2.11

The torsion from Colomb and Tredgold's results.

TABLE III.

Molecular Properties of the principal Materials for the Construction of Artillery.

1	2	3	4	5	6	7
No.	Material.	Chemical Constitution.	Specific Gravity.	Relative Torsion of Rupture.	Temperature of Maximum Strength.	Coefficient of Expansion for 150° Fahr.
1	Gun-Metal .	Cu ₈₇ +Sn	Mean. 8.450	Degrees. 367°	32°	.001816
2	Cast-Iron . .	Fe.C+ $\frac{C}{100}$ +m	7.200	52°?	300°?	.000893
3	Wrought-Iron	Fe.C+m	7.750	330°	360°	.000984
4	Steel	Fe.C	7.800	200°	?	.001225

		8	9	10	11	12
No.	Material.	Specific Heat.	Coefficient of Conduction for Heat.	Relative Hardness.	Relative Resistance to Abrasion.	Relative Oxidation in Moist Air.
1	Gun-Metal .	0.110	? 236?	? 5	? 10.5	? 10?
2	Cast-Iron . .	0.134	100	10	39.4	.42
3	Wrought-Iron	0.109	110?	20	322.6	.54
4	Steel	0.109?	100?	40	968.4	.56

Col. 11, = hardness $\times T_g$.

Col. 12, from the Author's experiments, Trans. Brit. Ass.

TABLE IV.

Comparative Financial Relations of the principal Materials of
Construction for Artillery.

1	2	3	4	5	6
No.	Material.	Average Cost per Ton in Guns in England.	Relative Section for equal strength.	Relative Weight for equal strength.	Relative Money Value for equal strength.
		£			
1	Gun-Metal . .	160	1.60	1.880	5.33
2	Cast-Iron . . .	30	1.00	1.000	1.00
3	Wrought-Iron .	60	0.33	0.354	2.00
4	Steel	180	0.21	0.226	6.00

		7	8	9	10	11
No.	Material.	Relative Money Value for equal weights.	Relative Durability in Service where never overstrained.	Unservice- able value as old Material per Ton.	Loss per Ton on the first cost.	Relative Costliness, Capital and Durability included.
				£	£	
1	Gun-Metal . .	10.02	4	60	100	251.00
2	Cast-Iron . .	1.00	1	4	26	100.00
3	Wrought-Iron .	0.70	22	6	54	3.25
4	Steel	1.36	156	15	165	0.87

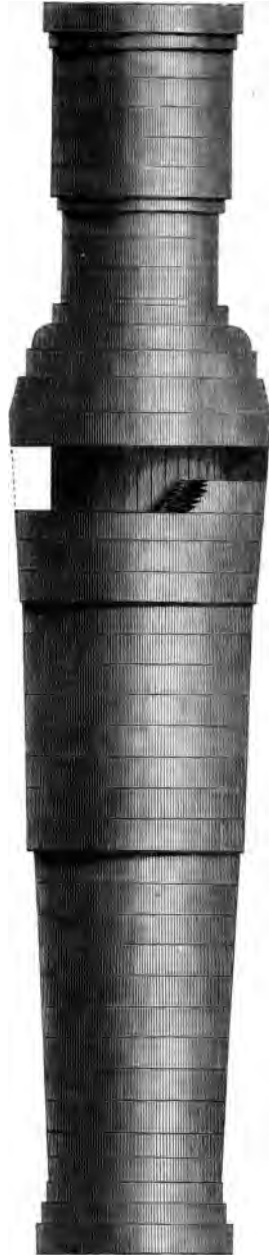
NOTE.—Cast-Iron is taken as unity throughout.

The relative strength is as opposed to static forces.

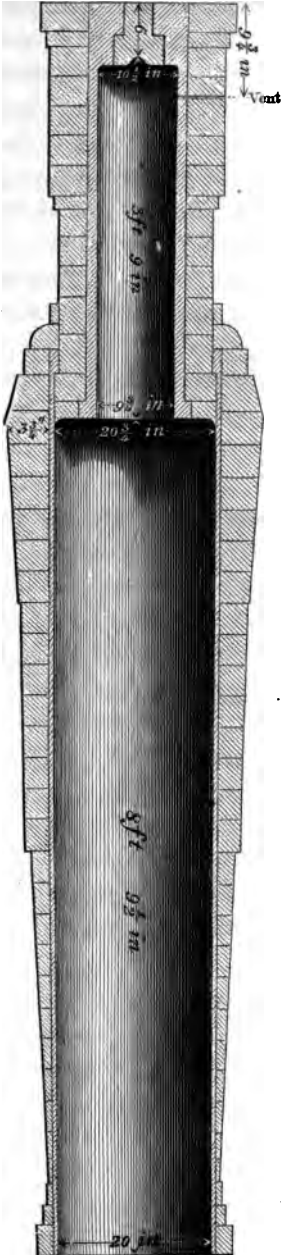
The relative durability takes account only of abrasion and corrosion.

Col. 10 = col. 6 × reciprocal of col. 8.

When we advance from the small calibres of field-guns to those already demanded for garrison and siege purposes, and to the still larger calibres that the most modern uses of stone and iron in fortification, in or out of connection with earthwork, have now demanded, it is obvious that we *must* resort to wrought iron as the material for our immense artillery, and that we *must apply this material in such a form as shall develop its best strength and powers of resistance, and according to methods the cheapest and the most certain in manufacture.*

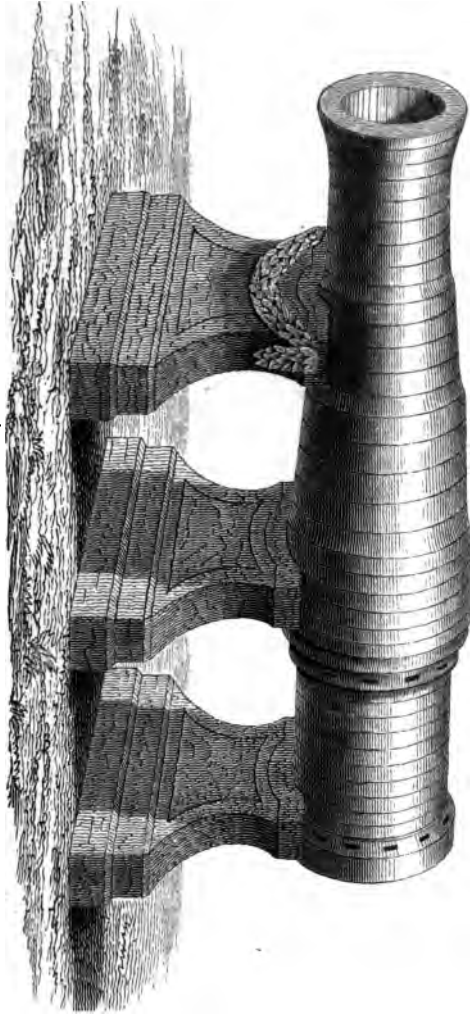


MONS MEG, EDINBURGH CASTLE.—EXTERNAL ELEVATION.



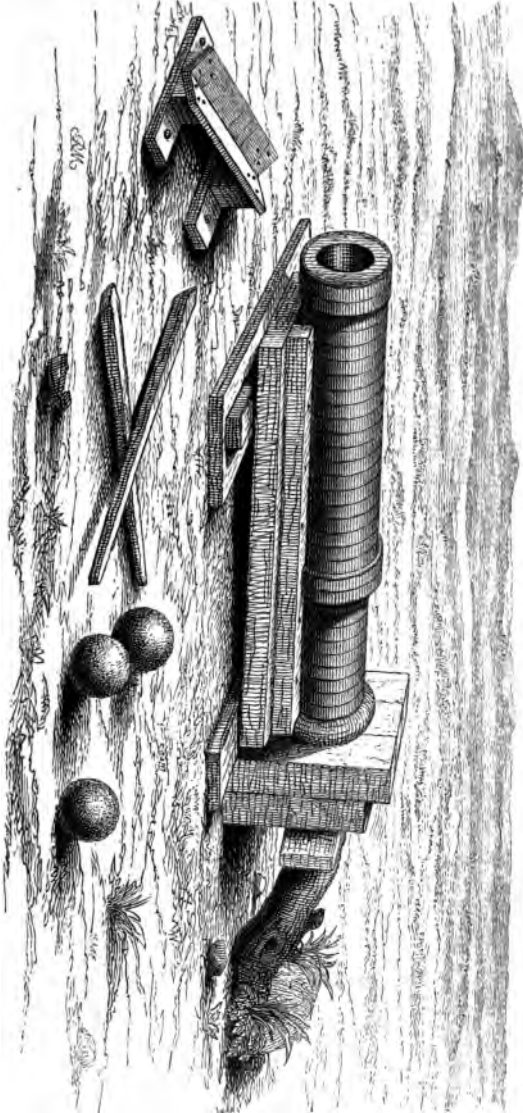
MONS MEG, EDINBURGH CASTLE.—LONGITUDINAL SECTION.

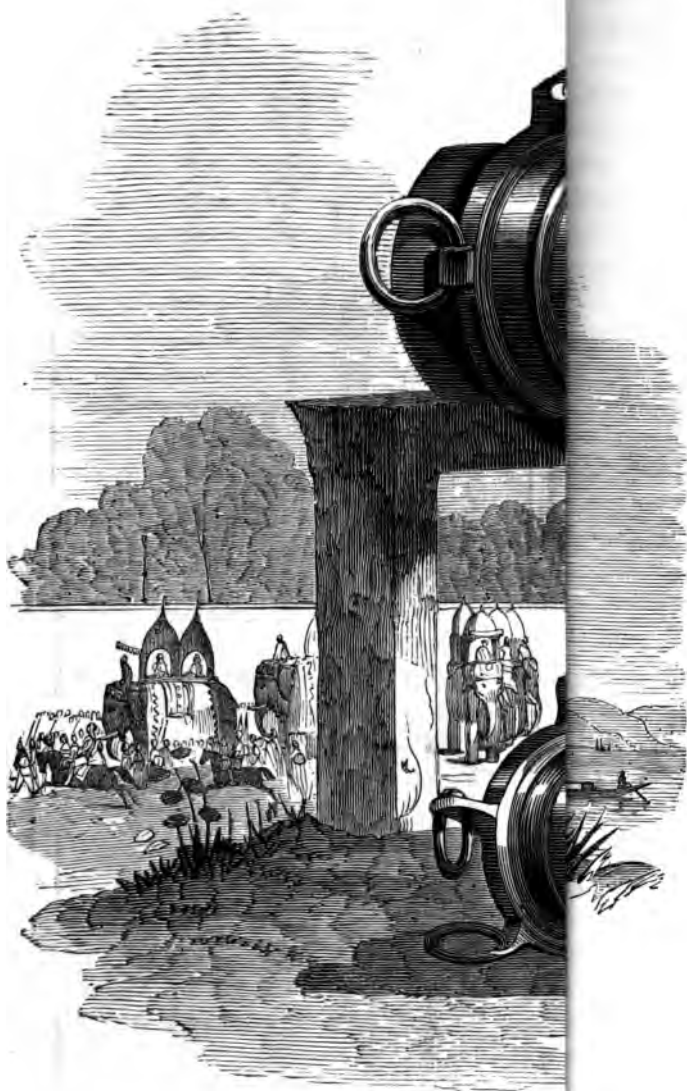
GREAT BOMBARD OF GHENT.





BOMBARD ON BED.





These methods develop themselves in the form of built-up guns, a construction the germ of which is very ancient, as may be seen in the drawings which I am enabled to exhibit of some ancient bombards of wrought iron, viz. the Mons Meg at Edinburgh Castle, the great bombard of Ghent, and, probably most ancient of all, the great bombard at Moorsshedabad in Bengal. (Plates IV. V. VI. and VII.)

The built-up principle was adopted in these pieces of great calibre, not from choice unquestionably, but because the imperfect methods of iron manufacture of those remote times left no option to their constructors. They acted without any accurate theoretic knowledge of the strains they desired to resist, or of the properties and measure of passive resistance, of the material they employed. Accident, however, compelled them to a structure in great part theoretically correct, so far as it was carried, but the immense mechanical advantages of the *superposition of hooped plies* was unknown to the makers of the ancient bombards, indeed theoretically unknown until very recently.* Yet if such powers of resistance, as we know the middle age kamerlicks and bombards to have had, were obtained by untaught craftsmen, and with the feeble tools and defective metals of their days, may we not anticipate much from exact science and the marvellous powers of modern tools, when moving together in advance upon the same road that led to these ancient successful attempts?

To recapitulate then some of the advantages which the method of built-up wrought iron guns offers, they are, as respects the material itself—

- 1°. The iron constituting the integrant parts is all in moderate sized, straight prismatic pieces, formed of rolled bars only; hence, with the fibre all longitudinal, perfectly uniform, and its extensibility the greatest possible, and in the same direction in which it is to be strained, it is therefore a better material than any forged iron can ever by possibility be made.
- 2°. The limitation of manufacture of the iron thus to rolling, and the dispensing with all massive forgings, ensures absolute soundness and uniformity of properties in the material.
- 3°. The limited size of each integrant part, and the mode of

* See Mallet on the Physical Conditions involved in the Construction of Artillery. 4to. 1855. Notes.

preparation and combination, afford unavoidable tests of soundness and of perfect workmanship; step by step, for every portion of the whole. Unknown, or wilfully concealed, defects are impossible.

4°. Facility of execution by ordinary tools, and under easily obtained conditions, and without the necessity either for peculiarly skilled labour on the part of "heavy forgers" or for steam or other hammers, &c. of unusual power, and very doubtful utility; and hence very considerable reduction in cost as compared with wrought iron artillery forged in mass.

5°. Facility of transport, by reduction of weight, as compared with solid guns of the same or of any other known material:

And as respects the mode of application—

6°. A better material than massive forged iron, is much more scientifically and advantageously applied; the same section of iron doing much more resisting work, as applied in the gun built up in compressed and extended plies, than in any solid or other gun.

7°. The introduction thus into cannon of a principle of elasticity, or rather of elastic range (as in a carriage spring, divided into a number of superimposed leaves), greater than that due to the modulus of elasticity of the material itself, and so acting by distribution of the maximum effort of the explosion, upon the rings successively recipient of the strain, during the time of the ball's trajet through the chase, as materially to relieve its effects upon the gun.

In a word, we secure better material and apply it better. It is upon these principles that I have designed for Government the great thirty-six inch mortars, to throw a shell of a yard in diameter, and weighing in flight above 8000 pounds, which are now nearly completed.

Had time permitted, I proposed, under the third and last head of our subject, to have considered the effects upon cannon, of another class of molecular forces, namely, those due to expansion by heat in service, and especially to have shown the enormously increased strains produced on cannon, both in very rapid firing and in firing

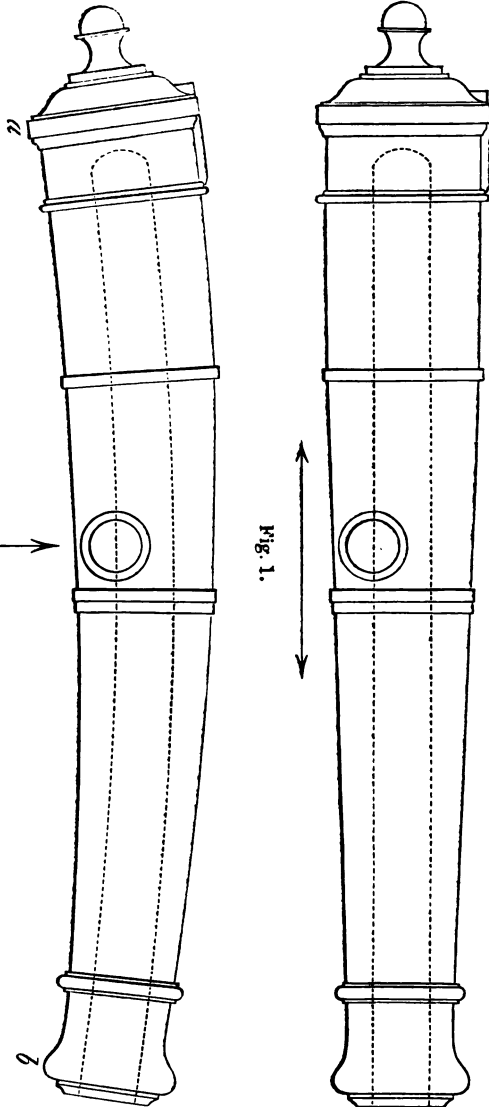


Fig. 2.

DROOPING AT THE MUZZLE IN BRONZE GUNS.

red-hot shot, by the unequal expansion of the interior and exterior of the gun; the more expanded interior producing a powerful splitting strain upon the exterior, independent of and before the application of the expansive effort of the exploded charge; and, again, to have pointed out the true solution of the long well-known phenomena, especially in heavy bronze guns, occurring after rapid and sustained firing, known as "drooping at the muzzle."

I can at this late hour, however, only venture to enunciate merely, that "drooping at the muzzle" is not due, as commonly asserted, to softening of the bronze gun by heat, and its becoming then bent by its own weight, but that it arises from the conjoint effect, of longitudinal expansion of the gun by the heat of repeated discharges, and the *relatively greater cooling* of the lower half of the gun by the continual *evection* of heat from its lower side, due to the ascent of the currents of atmospheric air which reach the gun, become heated by it, ascend as they become lighter than the surrounding colder air, and so carry off heat faster from the lower than from the upper side of the gun. This is true whether the gun be in still air or in a current of wind transverse to its axis, the chief difference being, that in the latter case, the gun is distorted more or less laterally as well as in the vertical plane. The play of forces producing this somewhat curious train of effects will, I trust, be easily understood by referring merely to the diagram exhibited. (Plate VIII.)

For a more full investigation of the whole subject of the effects of expansion by heat upon guns in service, I must again refer to my work "On the Physical Conditions involved in the Construction of Artillery," where I have shewn *how much* superior in this respect, as in all others, wrought and even cast iron are to bronze as materials for ordnance.

Perhaps at a future time I may be enabled to lay before the Members of the United Service Institution some of the grounds upon which I consider that cast steel, which has had a good deal of popular and ill-thought-out advocacy, latterly bestowed upon it, is an unsuitable material for cannon; indeed, some of these grounds may be gathered from the four comparative tables of the properties of the constructive materials for ordnance which I have had the honour to present to the Institution this evening.

Note—On the MOLECULAR CONSTITUTION of SOLIDS.

THE law of crystalline arrangement in crystallised masses, which passes as a clue of illustration throughout this Lecture, would demand a separate work, to treat it as its important relations to many of the most interesting questions of physics, and its enunciation, with clearness, would deserve.

To fulfil this in a note is impossible; a few remarks should, however, be added to the text. By principal axes of the integrant crystal, in metallic masses becoming crystallometrically arranged, under the influence of heat or pressure due to its motion, I do not necessarily mean the optic axis, even such determinable for opaque bodies, such as the metals, but that symmetric axis of the integral crystal, whose position, after consolidation of the mass, is found coincident with the direction in which the heat wave has passed out from the mass, if cooling, or into the mass, if heating; and which direction is necessarily that of least pressure within the mass, the pressure being that due to distortion or change of form, by contraction or expansion. As matter of observation, this is found to be the longest axis of the crystal in metals.

But, although not ascertainably the optic axis in metallic crystals, future investigation will most probably show, through such transparent bodies as assume in mass the same crystallometric arrangement, that the principal axis, as the term is used by me, has direct relations to the optic axis.

It is certain that it must have immediate relations to the axes of elasticity of Fresnel, which again are in direct connexion with the optic axes, as Savart has shown. The relation of these latter to local or unequal pressure within the mass has already formed the subject of masterly investigations by Seebeck, Biot, Fresnel, Brewster, and others; and the analogies between the optic effects due to pressure and to change of temperature have been lucidly pointed out by Sir John Herschell, who has well explained that in heating or cooling masses, such internal strains or pressures are produced by expansion or contraction as reduce the proximate cause of the phenomena simply to one of pressure; heat itself having (as inferable from those facts) no specific action on the crystalline arrangement, but being merely the means through which internal and unequal pressures are produced. Mitcherlich's facts, long since ascertained, as to the unequal expansion of crystals in certain systems in different axes, even when uniformly heated, indicate unequal elasticity in their respective axes, as well as unequal resistance to the transmission of the heat wave; the latter fact—the inequality of conducting power of crystalline bodies in different axes—is sustained by the researches of Senarmont ("Annal. de Chim." 3 ser. xxi. 457; xxii. 179; xxviii. 279), in papers of the highest interest. He even found that unequal pressure

in homogeneous uncrystallised solids, altered their conducting power in different directions.

These mutual relations are elucidated in Sir John Herschell's article Light, "Encyc. Britt." vol. iv.; arts. 1000, 1085 to 1097, 1113. They form at this moment the frontier and vantage ground of future conquest at once in physics and chemistry. (See also Maxwell's Papers on Elasticity, and on Faraday's Lines of Force, "Camb. Phil. Soc. Trans." December 10, 1855.)

It has been questioned to me how far the fundamental fact is established, that iron, in its several conditions of cast iron, steel, and especially of malleable iron, is truly crystalline at all; whether it may not be possible that the texture of a long, silky-fibred bar of rolled wrought iron is due simply to the extension and drawing out, long and fine, of a heterogeneous mixture of amorphous metal, and of included and uniformly distributed "cinder" (i.e. oxides, silicates, and carburets), which might be supposed to form together the mass as first withdrawn from the refinery or balling-furnace, much like as a mass of bird-lime and dry clay, diffused through it, would probably roll or draw out.

I cannot admit the force of the objection, or of the analogy.

All the evidence we possess is in favour of iron having a truly crystalline structure. This is the structure of all so-called elementary bodies, and assumed with distinctness (*cæteris paribus*) in proportion as they approach to chemical purity; not only the analogy here, but that nearer with all other metals, would be broken by such assumption, the crystallizing power being evidenced in all, though developed with very different facility, still in an unbroken chain, from bismuth and antimony, down to whichever may be held most difficult to obtain in crystals from fusion. But there is positive evidence of the power of cast-iron, of steel, and of malleable iron to assume the crystalline structure. The form of the integrant crystal is obvious; perfect crystals may be isolated; they possess the property of distinct cleavage in well-developed instances (Wöhler); and the fresh surfaces, often of great size, possess the perfection of plane and of polish that crystallization can alone confer. Other less broad and obvious characteristics, such as difference of resistance to the action of menstrua in different axes, might be urged. Or again, the difference of elasticity of (chemically the same) iron in different states of developement of the crystallization of the whole; and difference of elasticity in different axes in the same mass, following observable differences in the prevailing directions of the crystalline axes.

In a word, there appears no more good reason to doubt the true crystalline arrangement of the molecules of iron than there would be to doubt that an isolated octohedral crystal of native gold was truly a crystal, because, by the blow of a hammer, we can flatten it into a spangle. The masking circumstance is alike in both cases. Metallic

crystals are all more or less malleable; they are, therefore, susceptible of distortion (to almost any extent, in the most malleable metals), and of re-formation, without further external change in the mass.

But an additional argument may be drawn from Professor William Thompson's views as to the nature of the forces concerned in thermo-electric currents, from which it would seem to follow that iron, or any other body in which a thermo-electric current can be excited, can have none other but a crystalline arrangement. (Thompson, "Dynamic Theory of Heat," *Phil. Mag.* 1856.)

In addition to the several examples quoted of the arrangement of crystalline axes perpendicular to the bounding planes of the solid, I would remark a very interesting one, given by the late Professor Daniell, "*Elem. of Chem. Phil.*," sect. 117, p. 88:—If a parallelopiped of tin—hammered or cast, matters not—be placed in mercury for some time, the latter is absorbed gradually: it enters the mass by successive plane couches parallel to its surfaces; expansion is produced in the planes of these couches, and hence lines of least pressure perpendicular to the same. After a time, the parallelopiped is found split up into six pyramids, by planes penetrating from its edges, and intersecting within it,—their bases being the original sides of the solid; and each of these pyramids is found composed of crystals, whose longest axes are arranged perpendicular to the original sides, and parallel to each other; and into these integrant crystals each pyramid may be subdivided.

Here is a case in which chemical change—resulting in the formation of, no doubt, a definite amalgam—has resulted, owing to the peculiar circumstances of its formation in a state of crystalline aggregation, similar to that which mere change of temperature would have induced in the parallelopiped of tin, had the latter been large enough for internal strains to have so arisen.

Again, the following curious experiment, made by myself several years since, but not previously published:—If a portion of "Muntz patent yellow sheathing-metal" in the state in which it is used in common for ship's sheathing, bolts, &c. namely, in which it is tough, malleable, extremely flexible, and endowed with a distinct fibrous arrangement in the directions in which it has been laminated or rolled—if of this a small rod, or a narrow slip, be cut from a sheet, and plunged for a moment or two in a tolerably strong solution of nitrate of mercury, and then withdrawn, washed, and wiped dry, it will be found that it has almost instantaneously become rigid, and so brittle that it may now be broken into short bits between the fingers, whereas previously, reiterated bending backwards and forwards between the hands would have with difficulty broken it at all.

The surface of the metal is found slightly amalgamated; its fractures present crystalline planes, penetrating the solid in directions perpen-

dicular to its faces; and, on examination of the fracture with a lens, an extremely superficial, but real, penetration of the mercury between the surfaces of the crystals will be observed to have occurred.

The conditions here are varied. The phenomena occur with much greater, indeed with truly remarkable, rapidity, the transmutation from toughness to brittleness being instantaneous; but the results, and their explanation, are the same as in Daniell's experiment.

Chemical change, then, does not prevent this inversion of crystalline axis; on the contrary, if it induce the required condition of internal strain, it may produce the same crystalline arrangement that heating, or cooling, or local pressure can do.

Mineralogy and lithologic geology are full of examples of the play of these crystalline forces under the influence of pressure due to gravity, or to change of temperature; and some of its obscurest phenomena are yet destined to receive light from the application to them of the general law enunciated in the text.

What geologist is there who has not observed, that the integrant crystals, forming the mass of quartz and other such thin veins in igneous rocks, are all arranged in lines perpendicular to the bounding planes of the original fissure—the lines of least pressure in the mass, as it was heated or cooled by the surrounding rock?

Upon a greater scale, we find the metamorphic crystals of changed rock adjacent to dykes of igneous rocks—as the chalk penetrated by trap in Antrim,—stretching away from the walls of the dyke in lines perpendicular thereto; and the arrangement of the trap, so far as it is crystalline at the surfaces of contact, obeying the same law. In Scotland, coal converted naturally into coke, by intrusion of a trap-dyke, assumes the pseudo-crystalline structure known of it in planes of fracture perpendicular to the bounding planes. Perhaps even the yet unsolved mystery of the structure of columnar basalt may find its key and solution,—not in this law, but by views which it shall suggest; as well as the molecular conditions, upon the physical action of which the lamination and cleavage of the slaty and other rocks of apparently perfectly homogeneous material has depended; the directions of the pressures concerned in which Mr. Sharp has developed with so much ability.

The navigator in high latitudes has long been familiar with the dreaded fact, that the thawing iceberg, as it floats upon the ocean into warmer latitudes, often suddenly—without apparent external cause, or by any that shall produce the slightest vibration, such as the firing of a gun—splits up, and parts asunder into enormous spiriform masses, whose bounding planes are generally nearly, or quite, perpendicular to the surface of the sea, and which fall with fearful commotion, and stretch their lengths upon the bosom of the deep. The same law has acted here upon a still vaster scale: the whole berg, reduced nearly to its melting-

point, has received, by conduction from the ocean beneath, and from the air above, its heat in directions mainly vertical, and its splitting planes are so likewise; for the directions of greatest internal strains are, on the whole, horizontal. Its long fragments, if large enough, obey the same law, but in directions now at right angles to that in which it acted upon their parent berg. We may even imitate all these phenomena, upon a small scale, by heating a block of American ice slowly, by one of its flat surfaces, upon a heated plate of metal or of water; or we may observe them in play in the cross fractures of the thick ice of every pond, as it becomes rotten, and breaks up at the thaw.

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LECTURES.

June 12th, 1857.

COLONEL THE HONOURABLE JAMES LINDSAY in the Chair.

ON THE MILITARY ROADS OF THE ANCIENT ROMANS,
COMPARED WITH MODERN BRITISH RAILWAYS.

BY THE REV. R. BURGESS, B.D.

I PURPOSE in this lecture to enumerate and describe those great works of the ancient Romans, with a view of comparing their magnitude with the cast iron lines that now traverse a single province of the old Roman dominions. Unpromising as this subject may seem, it has already occupied the attention of archæologists. Nicolas Bergier, the French antiquary, who died in 1623, has left two quarto volumes which he entitled *Histoire des Grands Chemins de l'Empire Romain*. Pratilli, a writer of the last century, has left a book on the *Via Appia*; and Volpi, in his work on *Latium*, treats of the roads which traversed that region. These learned writers, however, tell us nothing of the Macadams of those classic days, and never rise to the idea of a good turnpike road, with our usual quantity of toll

bars. The Latin grammarians distinguish three different denominations of roads: *Via*, *Actus*, *Iter*. The *Via* answers to the French Route Royale, and was the great main road from one capital or province to another; such were called *Vie Consulares*. *Actus* we should call a bridle-road, about half the size and dignity of the *Via*, adapted for donkeys and bipeds; and *Iter* seems to be a general term for any path wide enough to travel upon. The office of taking care of the public roads devolved upon the *Curatores*, who appear to have had about the same power to inflict penalties for damages or trespasses as our railway companies have to keep the third class in order. Some grand lines of road were planned and completed during the Republic, but the earliest and most successful roadmakers of the empire were Julius Cæsar and M. Agrippa; of the latter Dion Cassius says, that when he was *Ædile* in the year of the city 721, he restored all the roads without taking a penny from the public treasury. The Emperor Augustus, of whom it has been truly said, that, with all his power and might, he had neither a glass to his window nor a shirt to his back, was magnificent enough to make up the Flaminian way as far as Ariminum at his own expense, and ordered the senators to do the same to all the other roads at their expense; he made also the *Milliarium aureum*, of which I shall shortly say something, and on the occasion of this general repairing of all the roads that issued from Rome, medals were struck in commemoration of the same, with the superscription *Quod Vie Munitæ sunt*. Nero repaired all the roads in Spain, and I believe modern travellers in that country would like much to see him there again. Vespasian was a great restorer of the public *Vie*, and Trajan's restoration of the *Via Appia* is immortalized in sculpture. Marcus Antoninus undertook the roads in Germany and in Belgium; and the emperors in succession, however neglectful they might be in other matters, seldom got through their career without a little engineering in this line. Finally, Theodoric is the last of the men of power we read of who repaired roads in Italy. The devastating war of the Goths and Greeks put an end to all such useful enterprises, and the roads became for many centuries almost impracticable. The materials, torn up or pushed from their site, were used for erecting towers of defence, or walls to prevent

incursions of barbarians, and not until civilisation began to dawn did the highways receive any attention from the reigning powers of Italy.

I shall now say a few words upon the materials and construction of the *Vie Antiquæ*. Vitruvius does not disdain to give directions for making roads; he recommends that the engineer should choose solid ground and level it, and upon this lay his first covering; and that if there be any looseness in the soil, he must consolidate it by means of wooden piles—"Fistulationibus cum magnâ curâ solidetur." We should hardly imagine that this is a subject for poetry, but yet it is from a passage in the Poet Statius that we chiefly learn how a road was commenced. First they cut two parallel furrows, to indicate the width of the road, and then they cut down between those until they came to the hard bottom, and then began the leveling. As the construction proceeded, the road assumed a slight convex shape; the middle or top was called the *dorsum*, or back-bone of the way, or, as it is called in Virgil, "in aggere viæ;" roads that were left in the rough material were said to be *munitæ*, but when covered with cut polygonal blocks, it was a "*via strata*," from whence is derived the Italian *strada*. Specimens of this "*opus stratum*" are still existing on the *Via Ostiensis* and the *Via Appia*, in the neighbourhood of Rome, but a piece in the best preservation is on the *Via Albana*, the triumphal way that led up to the temple of Jupiter Latiaris, on the Alban Mount; the letters V. N., *Via Numinis*, may still be read upon this pavement, which has kept its place for near 2,000 years. All these remains, and many others that might be enumerated about the hills of Frascati, Præneste, and Tivoli, are of the same description, being composed of large polygonal blocks of basaltic lava, found in many places near Rome, particularly in the quarries near the Lake Regillus, under the Capuchin convent near Bovillæ, also near the sepulchre of Cecilia Metella. This sort of stone was called by the ancient Romans *silex*, or *lapis siliceus*, and the places where it was got were called *lapidicinæ siliceæ*; it will be sufficient to offer for your inspection some specimens of this material, which I gathered with my own hands in Italy. The Roman *Vie* were edged by a step on each side; these were called *crepidinæ*, *margines*, or *umbones*; they were about nine inches in

elevation. The other materials used in roads were a mixture of broken fragments of all sorts, called "rudus," which we should call in plain English, rubbish; terra cotta, called testa; and that most plentiful of materials used in all the works of Rome, tufo. I also offer some specimens of that article taken from the quarries described by Vitruvius, near Rome. The Roman roads issuing from the gates of Rome, or branching out in the immediate neighbourhood, were twenty-nine in number; they were measured by a thousand paces, Mille Passuum, which is the origin of the word mile, and short round pillars, called milliaria, marked the distances from each gate. In the Forum there was set up a pillar, on which were inscribed the distances from Rome to each city, where the roads respectively had their terminus. The distances were not measured, as has been erroneously supposed, from this pillar or golden milliarium, but they were measured from the gates. This fact of the distances being measured from the gates, is ascertained by the first milliarium on the Via Appia having been found in its place in the Vigna Nari, on the right of the St. Sebastian gate, and the distance of a 1,000 paces being measured by Fabretti towards Rome, was found to coincide with the ancient site of the Porta Capena. The principal roads issuing from the gates of Rome are exhibited on the sketch before you, but you will not expect me to travel with you on them all. I must select two for notice and one for detail, when I have first stated the authorities we have for the names, number, and direction of all the roads in the Western empire. There are three ancient itineraries which have come down to us, enumerating, like a modern *Livre de Poste*, the various roads and distances from place to place. The first is commonly called the Itinerary of Antoninus, because it was made and published during the peaceful reign of the Antonines, the golden period of the Roman empire. During those forty years of peace and good government, the arts and useful public works were encouraged; and it is one of the blessings upon which we may congratulate the profession of architectural science and art, that it flourishes best in the atmosphere of peace and good will on earth. The second Itinerary was discovered at Augusta (Aost), in the possession of a certain Conrad Peutinger, and is known under the name of the *Carta Peutingeriana*; it is evidently of Christian times, men-

tion being made of St. Peter's Church; the orthography betrays the corrupted language of the eighth century, but, notwithstanding these defects of composition and spelling, it is a precious document, and unique of its kind, being the only one that affords us the least information of the state of the world at that period. The third of these ancient Itineraries was found at Bordeaux; it describes the journey from that city to Jerusalem, and is known on that account under the title of the Jerusalem Itinerary; it appears to be of about the same date as the *Carta Peutingeriana*. These are the three documents from which is to be gathered all that can be known of the public roads of the Roman empire. The two ancient *Viae* best known to the present world are the *Via Flaminia*, by which travellers from the North enter Rome, and the *Via Appia*, by which they leave it to travel to Naples. The *Via Aurelia*, which led to *Centum Cellæ*, now *Civita Vecchia*, has recently acquired a celebrity which it never enjoyed in ancient times.

The *Via Flaminia*, however, does not proceed in the direction of the modern road to Florence beyond the *Ponte Molle*; after passing that bridge, which is two miles from the gate, the post road falls in with the *Via Cassia*, and the *Via Flaminia* leads into solitudes and Mount *Soracte*. This celebrated Roman road was constructed by *Caius Flaminius*, the unfortunate consul who fell at the battle of *Thrasimene*; at that time the *Flaminian gate* was at the upper end of the *Corso*, under the *Capitoline Hill*, so that it was always reckoned *ad Pontem III*. The *Via* runs through the *Campus Martius*; it ended at *Ariminum*, now *Rimini*, a distance of 222 miles; it passed through *Narni*, *Terni*, *Spoletto*, before it cut through the *Appenines* to reach *Pisaro*, and in some places, especially between the *Ponte Molle* and *Soracte*, considerable remains of it may be traced. The road which I shall rather seek now to describe, and make the object of comparison, is the *Via Appia*, upon which were bestowed the greatest care and expense, both under Republican and Imperial Rome. It was chiefly on the *Appian way* that the great triumphal processions approached Rome from the East; the chariot wheels of *Pompey* and triumphant *Sylla* moved over its pavement, which, in some places, still exists; its splendid sepulchral monuments on each side of it have left their skeletons to mark its

direction ; and we may still stand near the tomb of Cecilia Metella, and imagine, amidst the stillness which now prevails, the shouts of the applauding multitudes which welcomed Cicero from exile. This was called the Queen of Roads, as Statius the poet sings :

Appia Longarum teritur regina Viarum.

This road was first constructed by Appius Claudius, the censor, 310 years before the Christian era ; it was repaired and laid down in many places with new silex by Trajan, and, in all probability, made entirely anew from Beneventum to Brundisium ; several of the milliaria are still standing along the Pontine Marshes, bearing inscriptions which tell us that Trajan laid it down with silex, at his own expense, *silice sua pecunia stravit*, and the dates square with the 104th year of the Christian era. We have a graphic description of the Via Appia given by the secretary of Belisarius in the sixth century, which it will be interesting to hear. "To traverse the Appian Way," says Procopius, "is a distance of five days' journey for a good walker, and it leads from Rome to Capua ; its breadth is such that two chariots may meet upon it, and pass each other without interruption, and its magnificence surpasses that of all other roads. For constructing this great work, Appius caused the materials to be fetched from a great distance, so as to have all the stones hard, and of the nature of millstones, such as are not to be found in this part of the country ; having ordered this material to be smoothed and polished, the stones were cut in corresponding angles, so as to fit together in jointures, without the intervention of copper, or any other material to bind them, and in this manner they were so firmly united, that in looking at them one would say they had not been put together by art, but had grown so upon the spot, and notwithstanding the wearing of so many ages, being traversed daily by a multitude of vehicles and all sorts of cattle, they still remain unmoved, nor can the least trace of ruin or waste be observed upon these stones, neither do they appear to have lost any of their beautiful polish ; and such is the Appian Way." Whatever we may say about our modern railways and great works of the present century, the paving of Appius Claudius, made just 2161 years ago, might be safely recommended to the study of the Curators of Oxford

Street and the Marylebone Vestry the next time they lay their heads together to make a wooden pavement. I shall give but one specimen of the form of those ancient Itineraries to which I have alluded, by taking the journey from Rome to Capua, properly called the Via Appia; the further distance, from Capua to Brundisium, must be considered as an addition made subsequently. The Itinerary of Antoninus gives the stages and distances thus :

Ariciam	M. P. XVI.
Tres Tabernas	M. P. XVII.
Appii Forum	M. P. XVIII.
Tarracinam	M. P. XVIII.
Fundos	M. P. XVI.
Formiam	M. P. XIII.
Minturnas	M. P. IX.
Sinuessam	M. P. IX.
Capuam	M. P. XXVI.

The Via Appia coincides with the modern road that now leads from the church of S. Cesario, where the Via Latina branches out from it, to the church of S. Sebastiano; continual traces of the old pavement may still be seen, as the way runs between the naked masses of sepulchres to the ruins, commonly called Roma Vecchia; a little beyond those ruins, which appear to be the remains of a little castrum, the old via falls in with the modern road to Albano, which leaves Roma by the Porta S. Giovanni Laterano; at ten miles from the site of the ancient Capena gate, which stood under the Thermæ of Caracalla, is to be recognised the site of the ancient Bovillæ; and in going from thence, the Via Appia passes through the slope of the Alban hills, and reaches the Valley of Ariccia; here we find the first great work which belongs to this queen of Roman ways. The modern road passes through the town of Ariccia, but the old via passed beneath it, having to traverse a valley, and to sustain its level. It is here that we find those magnificent substructions to which I have already alluded; the whole extends for a length of 100 geometrical paces, and the greatest depth or elevation is 38 ft., the least 8 ft.; the whole is a solid mass, except three arches, used for economising of materials, and for greater solidity; and I do not perceive that, in the whole sixteen miles which we have now travelled from Rome on this via, there are any great cuttings or levellings

which would pass the ordinary labour of laying down a road; from Ariccia we descend to Genzano, and approach the Lake of Nemi.

The Via Appia, having now reached the edge of the Pontine Marshes, runs in a dead flat to Terracina; the next two stages (*mutationes*) after Ariccia, bring us to names consecrated in sacred history; the Christians of Rome thought it not a journey too far to go out, some thirty-three miles, and some fifty-one, to meet the great Apostle of the Gentiles coming from Puteoli, at Appii Forum and the Three Taverns. But at Terracina it was necessary to cut away the rock, to make room for a passage between Anxur and the sea-shore; the white rocks of Anxur still shine in the sun, as they did when Horace made his journey to Brundisium, and I consider this passage of the rocks of Anxur to have been the second great work in making the Via Appia. Sixteen miles further is the town of Fondi, and it is easy to see that much labour has been expended about that ancient town, and about Itri, in carrying on the straight line of road, but after clearing Formia, near the present Mola di Gaeta, the difficulties must have ceased; the famous Minturnian Marshes might require a large quantity of the *rubus* and *fistucationes* of Vitruvius, to gain a solid bottom, but nothing serious obstructs the engineer until he arrives at Capua, having effected a distance of 142 miles. There is one particular in which the engineering of Roman roads and modern railways coincided, they both pursued a straight line, both filled up hollows, or bestrode vallies and glens by viaducts and bridges, both cut through hills, and cleared away opposing rocks, and even a tunnel is not wanting to compare with some of our own, in the Grotto of Posilipo, near Naples, and the cuttings of the rocks of Anxur may be placed at humble distance with the blasting of the cliff at Dover. But in making these comparisons, it is always to be borne in mind that the ancients had no gunpowder, and wanted all those mechanical inventions which modern science has given us; but even in a comparison of manual labour and quantity of material, it might, I think, be shown that all the great works of the Roman Empire would hardly equal in the aggregate the works which now exist in a single, and that the most contemptible province of the dominions of Augustus Cæsar. Before I proceed to speak of our own great works, I will

enumerate some of those of the greatest celebrity belonging to the ancient Romans. The substructure of the Ariccian Valley may be calculated by cubic feet of masonry, if we may so call these large masses of stone laid one upon another ; taking those substructions at 500 ft. in length, 18 ft. in mean depth or height, and a width of 26 ft. as measured by Pratilli, and supposing the mass to be solid and uniform, we get an amount of 234,000 cubic feet. I have already mentioned the cutting of the rock of Terracina ; another example of great manual labour is to be seen in going from Rocca di Papa to the Via Latina, under the Mons Algidus ; the mount is cut for a considerable distance down to a depth of 50 ft., so as to give a narrow passage, in which the traveller finds himself a prisoner, if any one chose to block up the entrance either way. Again, three miles from Acqualagna on the Via Flaminia, not far from Fossombrone, there is a great work, a narrow passage cut out of a rock, a part of which is even cut through, so that an arch is formed over head ; it appears from traces of inscriptions, that Vespasian was the author of this bold enterprise.

We are all familiar with the Pont de Gard, near Nismes, which I cite because it was a bridge as well as an aqueduct. Perhaps, the greatest work of all is the Via Trajana, leading to his bridge across the Danube ; there, under a perpendicular cliff, a road is ingeniously cut out, and a foundation given to it by means of beams inserted in the rock ; and every one must admire the skill which has overcome such formidable obstacles to making a road. Drawings illustrative of this great work, and a detailed description, may be seen in Paget's work ; the bridge to which the Via Trajana led was the same as that which is sculptured on his triumphal column.

I shall hardly cite as works of human labour the wonder of the Phlegrean fields, in the Bay of Baiæ ; for there the earth has been cut and slashed by the power of volcanic action, and the ground tunnelled in various directions without the intervention of the iron instrument. The poets in these regions made an easy descent to Avernus. Even the grotto of Posilipo is half-formed by nature, and it must be confessed, wonderful as the passages are which are perforated in this alluring region, that the Box Tunnel would

swallow them all, and a single company of railway directors digest them at a sitting. But we have not seen all the magnificence or the industry of the Romans. In the *Itineraries*, published by Wesseling, Gale and Stukeley for Britain, and M. Danville for Gaul and Italy, we may acquire some idea of this branch of Roman economy. From the wall of Antoninus to Rome, and from thence to Jerusalem, that is, from the north-west to the south-east point of the empire, was measured a distance of 3,740 English miles; of this distance 85 miles only were sea-passages, the rest was the road of polished silex, such as I have described. Posts were established along these mighty lines of high road, so that a hundred miles a day might be with ease accomplished. In the time of Theodosius (as the historian Gibbon quotes from Libanius) a magistrate went post from Antioch to Constantinople; he began his journey at night, was in Cappadocia, 165 miles from Antioch, the ensuing evening, and arrived at Constantinople the sixth day about noon—the distance being 685 miles. This, however, is not equal to the speed with which the Tartar couriers go from Constantinople to Belgrade, often accomplishing that distance of 800 miles in five or six days. It is right to mention a fact related by Pliny, as affording an example of the quickest travelling in a carriage I am aware of in ancient times. Tiberius Nero, with three carriages, accomplished a journey of 200 miles in twenty-four hours, when he went to see his brother Drusus, who was sick in Germany.

We shall now turn to a single province of the Roman Empire, and we see with wonder and admiration how its resources of wealth and genius have surpassed all the glory of the then known world. The distance between the two extremities of the dominions of the Antonines, exclusive of sea-passages, was 3,655 miles. I am willing to suppose that this great line of road was laid down with polished stone, and might have cost as much per mile as the *Via Appia*. If we suppose our numerous turnpike roads (some of which were made at a great cost) to be a set-off against the branch roads of the Roman Empire, which were often inferior in construction, then we have about 5,000 miles of railway in Great Britain alone, to compare with the great line which joined Jerusalem with the Firth of Forth. We have no means of estimating the cost of a

mile of Roman road by any audited account of expenses, and it is not easy to make a comparison of labour. The following may help us to form some idea, rather than any estimate. In the high-level Bridge of Newcastle, the quantity of masonry, in piers and in land-arches, approaches, &c., is 681,609 cubic feet, and the cost of that masonry was £120,000. I find this to be about 3*s.* 6½*d.*, let us say 3*s.* 6*d.*, per cubic foot, and if estimated by the cost of labour, and the greater difficulty in the transport of material, I doubt whether the old Romans could do it for less. In those magnificent substructions of the Via Appia near Ariccia, we have found by measurement (taking the whole mass) about 234,000 cubic feet. Now the internal mass in all cases was, to use a Vitruvian term, *ad empletton*, or, as we might call it, rubble; making all due allowance for this, I should not have in the Valley of Ariccia, reckoning the stone-work 5 feet on each flank, more than 100,000 cubic feet, *i. e.* reckoning at 3*s.* 6*d.* per cubic foot, about £17,000 worth of real masonry; and this in the tenth part of a mile. In the whole length of the 142 miles to Capua, we do not find more than two other extra works, viz. at Terracina and at Fondi; so that the cost of the Via Appia would not probably exceed £32,000 (the average price of a mile of our railway) above the ordinary expenditure of making a common road. I confess this is a vague calculation, if even it can be called one; but if it should be raised to the utmost stretch of imagination, it would be insignificant, as to pounds sterling, by the side of our leviathan railroads. The following I have on good authority, as the average cost of a mile of railway throughout Great Britain; the cost being, of course, very unequal in different places:—

	£.
Land	6,000
Earthwork	5,000
Tunnelling	3,000
Masonry	3,000, ordinary line
Viaduct and Large Bridges	3,000
Permanent Iron Road	5,000
Stations	4,000
Law Expenses, Engineering, Svrveying, &c.	3,000
	£32,000.

If this be multiplied by 5,000, which was the aggregate length of

British railways in 1851, and is now, of course, considerably larger, we have the almost fabulous amount of 160 millions, a sum fully equal to ten times the revenue of all the Roman provinces in the time of Augustus. I have spoken of 234,000 cubic feet of masonry and rubble as contained in one of the great works of the Via Appia; the high-level Bridge at Newcastle alone, as we have seen, contains of masonry 681,609, of rubble 116,396, of concrete 46,224, total 844,229, besides 5,050 tons of iron, of which the Romans knew nothing; the whole cost of this undertaking was £234,450. The cubic feet of masonry in the Britannia Bridge, which we must consider as a viaduct, and the wonder of the present age, is 1,500,000, and the cost, approximately calculated by Mr. Edwin Clarke, was £601,865; the cost of the Conway Bridge, with £38,500 worth of masonry, was £145,190; and finally the Tweed Viaduct is said to contain two million cubic feet of masonry. We have then in these four great works alone—the Britannia and Conway bridges, the Newcastle and Berwick viaducts or bridges, near $4\frac{1}{2}$ millions of cubic feet of masonry; the whole costing not less than £1,280,000. That is to say, if we could find in the Roman Empire one hundred such works as the celebrated substruction of the Via Appia, they would hardly equal in masonry or stone-work these four productions of the “*ultimi Britanni*,” this is independent of such material as the ancient Romans could not procure, and for which we must not charge them;—9,420 tons of iron were employed in the Britannia Bridge, and 5,050, as I have said, in the high-level Bridge of Newcastle. It is probable that whole armies worked at the Roman roads, bridges, and viaducts, and it would not be fair to compare their mechanical apparatus with the scientific inventions of modern times; but it may be doubted whether they ever presented such a union of physical power as was seen one day on the Menai Straits, when 650 men were employed in raising the second tube of the great bridge, of whom 386 were sailors; and although, as I have said, we have but little or no data to go upon for making a comparison of expenditure and labour, yet we may gather enough to maintain the proposition, that all the great works of the Roman empire connected with their lines of communication did not equal the works of a similar kind which now exist in the

island of Britannia. Another thing which hinders us from making comparisons as to cost, we have in every line of railway £6,000 per mile for land—Appius Claudius cut through the country of the Volsci without asking the price, and dispensed with all juries for assessing damages. The “mutationes” (hovels where they changed horses) were all the stations that occurred on their line—the comforts of law expenses were not known, and I doubt much if the surveyors and engineers got £1,200 a-mile. I wish I could have found how many sestertia Trajan paid for his restoration of the Via Appia, but all the data I have to guide me in the calculation of that expenditure are, that Trajan paved the road out of his own money, *de sua pecuniâ stravit*; this, however, is more than can be said for many of the projectors of our modern railways—*de alienâ pecuniâ ferro straverunt*, i.e. they laid down the iron with other people's money, might be a more appropriate inscription. When Augustus re-made the Flaminian way to Rimini, he was the sole shareholder, and gave no scrip. Julius Cæsar and Marc Antony raised great works, but they knew nothing about raising dividends; but that which would have astounded them more than an irruption of barbarians, would have been a bill of £1,800 for every mile of road for parliamentary and law expenses; if this be a true average, which I have authority for stating that it is, then we may deduct from the cost of 3,740 miles of Roman road, which led from Scotland to Jerusalem, the sum of £6,732,000; and if those worthies of old time had been called upon to make 5,000 miles of road in the province of Britain, they might have economized 30 millions of our money by paying nothing for land. In estimating the value of a Roman road, therefore, we have to deduct £7,800 a-mile for land and law, and £4,000 for stations, and £5,000 for iron, before we come to the materials they were enabled to use; in other words, the materials of the Roman road and labour would not be more than half the cost of our railways, from the mere fact of certain expenses being absent, which they could not understand; but, although inferior to the Britons of the nineteenth century in the art of spending money, if judged by the present state of the science, they could not be despicable engineers—their levels were chosen on different principles, but their lines of roads passed through the same countries, and gene-

rally in the same direction, as our railways. A diagram taken from an article of the *Quarterly Review*, written some years ago, exhibiting a general view of the direction of the principal Roman roads in England, shows that on comparing one or two of our principal lines, we shall find that the Great Western, *e.g.* supplies the place, with a little deviation near Reading, of the Roman iter from London to Bath and Bristol; the Liverpool and Manchester, and on to Leeds and York, replace the northern Watling Street; the Eastern Counties follow a Roman way, and so of the rest.

In boasting of the gigantic steps which the art of road-making has taken in our time, we cannot afford to depreciate either the genius or the magnificence of the ancient Romans in this matter. If we have our railway under the cliffs of Dover, Trajan had his road under 2,000 feet of perpendicular cliff along the Ister; if we have our 5,000 miles of rails, the Romans had their 4,000 miles of chosen road, reaching from one extremity of the empire to the other; if we have our leviathan bridges and viaducts, the Romans had theirs over greater rivers and wider vales than we have to deal with; and, finally, if we had our glass bazaar, one-third of a mile long, in Hyde Park, they had a golden palace, which reached a whole mile on the Esqueline Hill. If we rise superior and look down upon the works of the Romans, it is not so much that we have gained in unskilful labour, as in science. Without the iron and the science, their works would be as great as ours; it is in mental rather than in any physical energies, that we have the pre-eminence; it is what our last great poet has called the "divine particle," which has been dilated by Him who gave it to man, that has enabled us to cope with the very elements, and wing our way against wind and tide over oceans and seas unknown to the ancients. The spirit of a man which is in him is capable of knowing the things of a man, and this capability it is the business of all associated bodies to foster and draw out; it is not, perhaps, yet known of what the human thought is still capable, but the blessing of every discovery in art or science which procures fresh enjoyment for man is, that it brings brute force to a discount, and teaches to mankind the lesson of fraternity and peace; and it is not perhaps too much to say that this question of roads, by which all nations of the earth are brought

within the possibility of meeting again on some plain of Shinar, is calculated more than any other human instrument to renew the face of the earth.

June 19th, 1857.

COLONEL THE HONOURABLE JAMES LINDSAY in the Chair.

THE MEANS OF PRACTICALLY APPLYING THE PRINCIPLES OF
MEDICAL GEOGRAPHY, FOR THE PRESERVATION OF
THE HEALTH OF SOLDIERS AND SEAMEN IN FOREIGN
CLIMATES.

By DR. BIRD, F.G.S.

LAST year I laid before you the principles of Medical or Noso-Geography; in other words, the facts of physical geography and vital statistics, inductively used for investigating the laws under which health and disease are distributed through the human family, and in various latitudes. On that occasion I brought to notice, how that this promising field of research forms only part of medical etiology, or a knowledge of the causes of disease, associated with geographical situation, and the climatology of particular countries; and that if those entrusted with the health of, or in command of, either soldiers or sailors in those countries, would but rightly appreciate the importance of the duties committed to them, they would endeavour to acquire useful knowledge of the influence of climate on health, and of subjects connected with the treatment as well as the prevention of disease.

The more material agencies which geographically regulate not only the diversities of vegetable and animal structure, but the production of disease also, are the geographico-meteorological causes of atmospheric temperature and humidity, measured by isothermal lines, which connect places having the same mean temperature, but which differ sensibly from the lines of latitude. The mean temperatures calculated from an equatorial mean of 81° 50' Fahr.,

according to Dr. Brewster's formula, and which differ considerably from the mean temperatures obtained by observation, are given in the annexed Table from Daniell's Elements of Meteorology:

	Latitude.	Observed Mean Temperature.	Mean Temperature calculated by Formula.	Difference.
Equator - - -	0° 0'	81°50	81°50	0°00
Columbo - - -	6 58	79°50	80°90	1°40+
Chandernagore - - -	22 52	75°56	75°10	0°46—
Cairo - - -	30 2	72°82	70°56	1°76—
Funchal - - -	32 37	68°54	68°62	0°08+
Rome - - -	41 54	60°44	60°66	0°22+
Montpellier - - -	43 36	59°36	59°	0°36—
Bordeaux - - -	44 50	56°48	57°82	1°34+
Milan - - -	45 28	57°18	58°28	1°10+
Nantes - - -	47 13	54°68	55°35	0°67+
St. Malo - - -	48 39	54°14	53°85	0°29—
Paris - - -	48 50	51°89	53°65	1°76+
Brussels - - -	50 50	51°80	51°47	0°33—
Dunkirk - - -	51 20	50°54	51°25	0°71+
London - - -	51 30	50°36	50°74	0°38+
Bushey Heath - - -	51 37½	51°20	50°58	0°62—
Kendal - - -	54 17	46°02	47°58	1°56+
New Malton - - -	54 10	48°28	47°53	0°75—
Lyndon - - -	54 34	48°90	49°37	0°47+
Dublin - - -	53 21	49°10	48°65	0°45—
Copenhagen - - -	55 41	45°68	45°95	0°27+
Edinburgh - - -	55 57	46°23	45°64	0°59—
Carlsrona - - -	56 16	46°04	45°46	0°58—
Fawside - - -	56 58	44°30	44°26	0°04—
Kinfauns - - -	56 23½	46°20	45°12	1°08—
Stockholm - - -	59 20	42°26	41°57	0°69—
Upsal - - -	59 51	42°08	40°94	1°14—
Abo - - -	60 27	40°00	40°28	0°28+
Umeo - - -	63 50	33°08	35°96	2°88+
Uleo - - -	65 30	33°26	34°38	1°11+

These mean temperatures are usually higher in the same latitude of the old world than of the new, and are greater in northern than in southern latitudes. Thus the isothermal line of 59° Fahr., traverses the latitude of 46° in Europe, but descends to latitude 36° in America. The general causes which disturb the symmetrical distribution of temperature, are, the annual variations of the upper equatorial and lower polar currents of the atmosphere, the difference of contained humidity, the unequal distribution of land and water in various countries, the peculiar nature of the surface land, and its relative height above the level of the sea. All these causes have more or

less influence in determining the local temperature or climate of places, and in fixing the isothermal lines that mark out the zones of disease.

It can be asserted only in a limited sense, and relatively, that certain class diseases are mainly *dependent* on, or *independent* of, temperature and moisture. Specific diseases of a miasmatic and zymotic kind are materially under the influence of these meteorological causes, aided by the concurrent ones of topographical situation, geological nature of and elevation of the soil, state of the vegetation, and domestic habits of the people. Those diseases, again, which mainly arise and prevail *independent* of such influences, or diseases called *dyscrasial*, which are of constitutional origin, and result from depraved conditions of the blood and impaired nutrition, are not limited by isothermal lines to particular quarters of the globe.

The class of miasmatic diseases and those of a self-generated contagious type, as remittents, yellow fever, plague, genuine typhus, and cholera, require a fixed amount of temperature and moisture for their production and prevalence. Dyscrasial or constitutional diseases of depraved nutrition—as cachectic ulcers, rheumatism, scurvy, and consumption, which arise from a special cell-degeneration in particular bodies, are not absolutely, but relatively, independent of temperature and atmospheric humidity; although consumption is more prevalent in the tropical than in the arctic regions.

The zones, or belts of disease, thus geographically marked out on the globe, are the *tropical*, *temperate*, and *polar* zones.* The north limit of the first is formed by the isothermal line of 77° Fahr. This line ascends somewhat in summer, when the sun is north of the equator, and descends again in winter, when the sun is to the south of it. While it forms the northern limit of the tropical zone, where we find the worst forms of malarious, intermittent, remittent, continued, and yellow fevers; and of those diseases found in alliance with them, as dysentery, diarrhœa, cholera Indica, and affections of the liver; it is also the southern bar to the prevalence of epidemic *contagious typhus*, which is the proper and peculiar product of the next, or temperate zone; whose limit southwards is the isothermal

* No map of these zones is here given, as the reader may find one in Mr. Keith Johnston's Atlas of Physical Geography.

line of 77° Fahr. and northwards that of 41° of the same scale. The polar zone, again, which extends beyond these two zones, is directly opposed in climate to that of the tropical zone. Its southern boundary is the line of 41° Fahr., while its northern limit extends 8° or 12° below the zero of Reaumur.

The temperate zone embraces the extreme climatic conditions of the two other zones, under the seasons of summer and winter. At these periods, the prevailing disorders, to which armies and military masses moved from one country to another are peculiarly subject, will partake alternately of the character of diseases prevalent within the tropical and polar zones. The results and experience of the Crimean expedition have afforded ample evidence of this fact. In the Crimea more particularly, and in all the European countries of this zone, both soldiers and seamen, but especially the former, will suffer greatly in summer from diarrhoea and dysentery, from intermittents, fevers of a remittent and continued type. The latter, under bad diet, and imperfect ventilation of the soldiers' huts and hospitals, soon degenerate into genuine *contagious typhus*. This true typhus, once so prevalent, and now but rarely seen, under a better and more scientifically administered sanitary system, as well as the true glandular plague, have their special habitation in this zone, between the thirtieth and fortieth degrees of northern latitude; and, though occasionally propagated beyond these limits, by a secondary and specific poison generated from human bodies, they have evidently a distinct primitive origin from atmospheric agencies.

Yellow fever, also, from the tropical regions, makes occasional incursions into this zone, when favoured, during summer, by tropical identity of climate. Under high degrees of temperature it has appeared, both at Gibraltar and Cadiz, and in America southwards beyond its usual limits, under like favouring circumstances. But, as soon as the temperature falls below 55° of Fahrenheit, the importation of yellow fever into this zone becomes impossible, and supersedes the necessity of quarantine. Plague, like the yellow fever, is limited to low, filthy localities, but differs from it by being destroyed by high degrees of temperature. Both are limited in their prevalence by elevation of site above the level

of the sea; such elevation being associated with decrease of temperature, exerts the same agency against their prevalence as do certain isothermal lines and increase of latitude.*

Having thus briefly recapitulated the principles of medical geography, which formed the chief heads of a former lecture, I shall, on the present occasion, point out the means of practically applying such principles for the preservation of the health of soldiers and seamen in foreign climates. Political motives, and the circumstances of warlike operations, frequently render it necessary that both soldiers and seamen should be located in unhealthy situations; but timely precautions, and the resources of hygienic knowledge, are capable of averting their injurious effects, when unacclimated masses of men are exposed to those external and internal agencies which pervert the normal condition of individual constitutions. When we reflect that, in this matter, causes susceptible of removal are, from prevailing ignorance, allowed too often to exaggerate the evils of disease, incident to assembled multitudes; we may well wonder why, until very lately, so little should have been done to apply the resources of professional knowledge, for the prevention and amelioration of diseases in our military settlements, and more particularly those consequent on warfare.

While soldiers are exposed, alike with persons in civil life, to topographical and atmospheric influences peculiar to the different geographical zones of disease, they are somewhat differently placed in regard to other agencies, to which the unfettered emigrant is not exposed, and to which he may at least accommodate his constitution. The principal of such agencies are the unacclimated and unmodified constitutional states of soldiers and seamen, suddenly removed from one geographical zone to another; the condition of their diet, drink, and cooking; the state of their clothing, barracks, berths, huts, hospitals, camps, and bivouacs; their marches, ordinary exercises, habits, and discipline. On the subject of these, certain rules are laid down for the guidance of men in the army and

* Dr. Lawson has forwarded home a paper on the late epidemic outbreak of yellow fever at Jamaica, in which it is statistically shown that this disease is occasionally prevalent beyond the now fixed limit of elevated site.

navy, from which they are not permitted to deviate, whether such rules may have been laid down with due regard to sanitary results or not.

In regard to acclimatation, we may observe, that not only do the states of the blood but the physiological conditions of the long resident and recently imported inhabitants differ. No better proof of this need be cited than the fearfully destructive effects of yellow fevers in the West Indies, which carried off thousands of our soldiers and seamen at the commencement of the last war, while the residents of those islands were comparatively exempt; and had the barracks and hospitals then constructed in those colonies been placed in better selected and more elevated sites than was the practice in those days, a vast saving of life and expense might have been earlier secured for this country.

From the high temperature of the tropical zones, and the consequent diminution of inhaled oxygen, the blood of the European becomes more loose and venous than in the temperate zone, is distributed more in the venous than arterial trunks, and gives rise to an increased elimination of bile by the liver; whose vicarious action, concurrent with the increased functions of the skin, is set up in aid of the respiratory function, in order to carry off the superfluous carbon of the blood. The necessity for producing the same continuous supply of animal heat now ceases, and with this ceases also the appetite for large quantities of nitrogenous and oleaginous food, which had been previously vigorous. Neither digestion nor respiration is in a condition to supply any longer the production of abundant rich blood, which is no longer wanted for the necessities of the system. Should nature, under such circumstance, not be thwarted by improper indulgences of drinks and diet, she increases those eliminating functions of the skin and liver by which the systemic blood is rendered poorer in quality, smaller in quantity, and suitable to the wants of the body. Dr. John Davy ascertained that, under high degrees of temperature within the tropics, the heat of the human body at first increases with the temperature of the air, and falls as the atmosphere cools, within certain limits.

Although his researches be little more than an approximation to truth, they have clearly established that, on first landing in tropical

climates, the standard heat of Europeans is raised two or three degrees, accompanied by febrile symptoms; that the reduction of the body's temperature to a normal state requires temperance and abstinence from alcoholic drinks, moderation in eating, and the sparing indulgence in animal food; with avoidance of all causes of excitement increasing vascular action, and particularly exposure to the sun. The tropical new comer should at the same time use cooling drinks, as sherbets of various kinds, and frequently have recourse to tepid ablutions of the body. In the East Indies a large proportion of the inhabitants use an almost exclusive vegetable diet; and in the West Indies the black and brown races indulge sparingly in animal food. The former, in respect to Europeans, are of comparatively feeble constitutional power, which exempts them from those more severe and venous congestive forms of fever that prove so destructive of the latter. This very feebleness makes native soldiers, *or Sepoys*, more subjects of rheumatism and emaciation after mild forms of intermittent fever, predisposes them to destructive ulceration, and renders them more susceptible of injury from large doses of mercurial preparations, and like heroic remedies which reduce the fibrinous condition of the blood. The black and creole races of the West Indies, too, though more liable than Europeans to suffer from diseases of defective nutrition, are less susceptible of those generated by plethora and constitutional vascular excitement. Cerebral and nervous affections are here more severe and common than in the temperate zone, and require for their prevention rigid abstinence from alcoholic stimuli. But many tropical diseases, among soldiers, are caused by sudden refrigerations of the body and vicissitudes of temperature. The period for acclimating Europeans is about two years.

In the temperate and polar zones again, where vital action is more energetic, and the blood more abundant and arterial, Providence wisely provides the increased density of the atmosphere, for maintaining the uniform temperature of the body, by the increased quantity of inspired oxygen, and a greater appetite for hydro-carbonized or heat-producing articles of diet and drink, such as starch, oil, fat, and hydro-carbonized stimuli. But just as the excess of carbon and hydrogen, in fat and oleaginous food, is requi-

site in very cold climates for maintaining bodily warmth, so is a due proportion of *nitrogenous* or nutritive food also necessary. Without a sufficient supply of *nitrogenous articles* of diet, animal and vegetable, containing flesh-like or proteine compounds, the nutrition of the body fails, its vital power becomes enfeebled, and scorbutic disease is established, whether the *diatetic restriction* be to the animal or vegetable kingdom. Diversified diet is thus necessary for the sustenance of the body in healthy degrees of vigour, even in the temperate zone of Europe; yet the natives of hyperborean regions, who cannot obtain farinaceous articles of diet, subsist exclusively on animal food of the coarsest kind, without degenerating in physical condition. Their purely animal diet of an oleaginous kind requires vigorous assimilating organs for its elaboration; and, as a greater quantity of oxygen is absorbed into the blood, a greater production of animal heat compensates for its more rapid subtraction by surrounding cold media. The inhabitants of the Arctic regions, when brought to this country, suffer much from the heat of our summer and autumn; and in this respect the Greenlander is similarly situated as the European, when transported for a few weeks to a tropical climate. The established functional actions of the animal economy, associated with certain concurrent conditions, generate more than the requisite degree of heat for the wants of the system; and, as the quantity abstracted is less than that produced, it rarifies and expands the circulating fluids, exalts nervous irritability, and increases vascular action.

The influence of foreign climates has been specially elucidated by the elaborate statistics of our army and navy. Investigation into the principles of medical geography, then, in relation to such influence, and the circumstances to which particular places are indebted for their salubrity or otherwise, may be viewed as the theory of *Hygiene*, or a knowledge of the external and internal causes of diseased action. The means of destroying these morbid causes, or the practical application of this knowledge for the prevention of disease among soldiers and seamen, in various climates, is the object of practical military and naval Hygiene. This is a subject of the greatest utility when directed to the adoption of measures likely to

diminish the great loss of life annually experienced in our settlements abroad. The true and practical end of Hygiene is to point out the best means of assimilating the human constitution to new employments and climates, and to recommend such measures as are sure of neutralising the effects of hurtful agencies, to which individuals or multitudes may be exposed. The means best adapted for obtaining the first end in view, or the acclimatation of the raw soldier or sailor to new climates, consist in the proper adaptation of their diet, clothing, and duties to the exigency of different seasons, and changes of external temperature and climate. Those calculated to avert the baneful consequences of the latter are such as are calculated to promote healthy conditions of barracks, huts, and hospitals; and to invigorate the constitutions of the men under command by well-regulated systems of diet, clothing, exercise, amusements, education, and punishments. In endeavouring to fulfil a promise I made, at the conclusion of my last year's lecture, to embody some practical recommendations and rules in reference to varied causes of disease, and with the object of preserving the health of troops, I shall now point out the practical measures most suitable for preserving the health of military and naval masses, in accordance with the principles of medical geography, which have been brought before you.

In 1821-30 the mean annual proportion of deaths for the entire Prussian army was 11·7 per 1,000 men, a very low ratio of mortality compared with other armies. This army is, however, composed of young men compelled only to three years' active service, and subject to but few changes of locality. The civil population of Berlin, at the same age, twenty to twenty-five, gave 10 deaths to 1,000 living. But the British army in 1819-28 furnished 15 deaths per 1,000 in the United Kingdom, 57 in troops serving beyond its limits, and 37 for the entire army. Taking the mortality of the British army within the kingdom at 1, it is 1·3 beyond the tropics, and 4 in intertropical regions. The present condition of the British navy demonstrates irresistibly the power of *hygiene* in diminishing the ratio of mortality. It was 13·8 per 1,000, or from internal diseases alone 11·8, for the period 1830-36, while seventy years ago it was 123, and less than forty years ago, 30. Official

records attribute this improvement to better diet, free ventilation, less severity of punishment, diminution of the rations of spirit, and less money left at the men's disposal. To the more prominently useful sanitary measures in regard to these objects I shall now advert. And, *first*, in regard to

DIET AND DRINK.—I have already given a brief outline of the peculiar physiological condition of well-nourished Europeans, at their first entrance into tropical climates; and have pointed out that with the change of circumstances a corresponding change of their usual articles of diet and drink becomes absolutely necessary, in order to maintain intact the body's organic functions. That, which the majority of individuals would not, in this respect, willingly or prudently submit to, is naturally forced on their acceptance, and against their artificial inclinations. The appetite for animal food is lessened, the inclination for cooling acid beverages in preference to spirituous drinks or malt liquors greatly increased, and the due performance of the cutaneous and other excretory functions, accompanied by gradual abatement of nervous excitement, thus duly maintained; but, should the harrassing nervous irritation and thirst, to which soldiers and seamen under such circumstances are exposed, ever induce them to seek relief from increased potations of fermented liquors, the very opposite of these healthful changes will be the consequence. The excretory functions of the skin and other eliminating organs are suppressed, the circulating fluids rendered more carbonaceous and impure, the nervous irritability rendered more oppressive, and all the symptoms of tropical fever with its dangerous accompaniments established. Colonel Sykes, in his valuable paper on the "Vital Statistics of the Indian Army," has, from the evidence of figures, given explicit testimony to the benefit of abstaining from the excessive use of fermented liquors under such circumstances; and, that when animal food is unsparingly used, and total abstinence from fermented liquors is not observed, the substitution of beer for distilled spirit will be the least injurious of pre-established habits, which proved not unhealthful in colder climates. He rightly associates the comparative healthiness of the Europeans of the Madras army with the increased consumption of malt liquors

by the soldiers of that presidency, and the gradations of mortality of the Bengal and Bombay European troops as partly influenced by the quantity of spirits respectively consumed. "I have a strong conviction," says the Colonel, "that much of European disease in India is traceable to over-stimulus, and that the mortality among the Europeans troops will not be lessened until the European soldier is improved in his habits, until he is made to understand that temperance is for the benefit of his body, libraries for the benefit of his mind, exercise for the benefit of his health, and savings banks for the benefit of his purse."

The diet of soldiers and seamen in tropical climates might be advantageously made a little more varied, by diminishing the proportion of nitrogenous or animal food, and increasing the quantity of farinaceous articles of diet, or of albuminous culinary vegetables. In the cold weather of the temperate zone, and in the polar zone particularly, increased proportions of animal and fatty food, with a moderate allowance of fermented stimuli for drink, either beer or wine, become necessary for the preservation of vigorous health; but if the same habits of eating and drinking be continued in hot climates, they are followed by their natural penalty, rapid disease, and premature death. Many have recourse to stimulants, in the vain hope of relieving the languor of body and depression of mind, which naturally attend a first residence in such climates, but they are soon cut off, the victims of their own imprudence and temerity. Fresh provisions of good quality, or salt meat in small quantities, free from septic tendency, and sufficiently cooked, are absolute requisites for the climates of every zone. The provision of iced sherbets and coffee in regimental canteens, and the introduction into the army of an evening meal for the soldiers, would be useful improvements on the system of diet. If spirits be drank at all, they should be so after being well diluted with common water, or, what is better, with effervescing soda or potass waters.

We cannot, moreover, doubt the pernicious effects that follow the habitual use of foul water, whether in camps or cantonments. The continuous introduction, from this source, of septic matter into the system predisposes it to be acted on by other morbid causes, even should this itself not become an exciting cause of disease. In tropical

climates it is either raised from wells, or obtained from tanks in which rain-water is collected. In either case it is impregnated largely with animal and vegetable matter, and becomes quickly fetid and putrescent. Remedial measures for correcting these evils are simple, and not expensive. These are,—keeping clean the reservoirs, boiling the water, and filtering it through charcoal. Small additions of wine or spirit to bad water may be sometimes advisable, but its purification is the more salutary process, as the action of alcoholic drinks on the blood, assisted by increased temperature, is to devitalize this pabulum of life.

DRESS.—With regard to *dress* or *clothing* for soldiers and seamen, it is desirable that this also should be suited to the climatic conditions of the different zones. The furs and woollen clothing which are so well adapted to retain the body's animal heat, in the temperate and polar zones, are altogether unsuited to its conditions in either tropical zone. It is not necessary that, in this matter, appearance should be altogether sacrificed to convenience, but surely it is quite unnecessary that, except on parades, either officers or soldiers should be buckled up in woollen clothing on all occasions, or that seamen in the performance of their ordinary duties, with the temperature at 96 to 100 of Fahrenheit, should be clad as under a polar sky. For hot climates a cool linen dress, made according to a pattern, should be officially sanctioned, so that one of the most common causes of disease, sudden refrigerations of the body, after excessive perspiration from over-clothing, might be prevented among the men. It is impossible to prevent soldiers from throwing off their coats to cool themselves after a march, drill, or parade, and the addition, therefore, of a flannel under-waistcoat, or flannel undress, must be at all times, in warm climates, an important addition to the soldier's dress. But defective clothing again of the soldier or seaman in cold climates, is frequently a main cause of their ill health, particularly when predisposed to pulmonary disease. Here flannel under-waistcoats and waistbands should, in general, be provided as absolute requisites; it being kept in remembrance that neither an over-coat nor any amount of extra clothing, in order to preserve warmth, can be a substitute for flannel next the skin, over whose functions it has a special sanitary influence.

In rules for the preservation of health, the benefit of attending to the condition of the cutaneous surface is scarcely second in importance to that of maintaining in healthy vigour the function of digestion. The skin is at once an exhalant of waste matter from the system, a joint regulator with the lungs of the heat of the body, and an agent of absorption amidst surrounding effluvia. Hence the importance of enveloping the body in warm woollen dresses, as practised by the ancient Romans, as the use of flannel next the skin guards against the evils of checked perspiration, regulates the animal temperature in warm climates, and prevents the absorption of deleterious effluvia in malarious countries. The more objectionable parts of the soldier's former dress, his stiff leather stock, heavy shako, and badly constructed knapsack with breast-straps, have been already altered and improved, and every alteration tending to lessen the weight which soldiers are obliged to carry on the march must be received as a boon to them.

BATHING.—External personal cleanliness is in a general way well enforced throughout the army; but the means of general ablution, now beyond the soldier's reach, should be provided for him in every range of barracks of any considerable extent. Warm and tepid bathing is of the first importance, as tending to preserve the healthy functions of the skin, both in tropical and temperate climates. It enables the body to accommodate itself to the changed conditions of new climates, until it becomes acclimated, and impowers the system to resist the morbid influences of malarious agencies generated in hot countries.

Such are the general means—diet, drink, dress, and bathing—for enabling the constitutions of soldiers and seamen to accommodate themselves to changed climatic conditions: and I will now in the *second place* notice the hurtful agencies to which military and naval masses may be exposed, and the best modes of neutralizing them. The most noxious of these agencies are found associated with the sites of barracks, hospitals, huts, and encampments, on shore; or the state of the round houses, sick berths, and hold of ships at sea. But, while each of those individual subjects might claim a lengthened notice, I must now briefly confine my observations to the morbid agencies which render these localities hurtful. Among these are low,

swampy, filthy, confined, 'ill-ventilated spots, producing malaria; insufficient breathing space in, and defective construction of, barracks, huts, and hospitals.

BARRACKS.—Medical topography is a most important branch of military hygiene, as it leads us at once to consider the various physical agents which influence the health of the soldier, and to remove him, when practicable, from all causes of endemic disease. In selecting sites for barracks, however, the military capabilities of the locality, rather than its sanitary fitness, have been usually thought of. The opinions of commanding officers, and of the engineer department, have consequently, on such occasions, been more sought for than those of medical officers. But it is the interest and the duty of Government to quarter troops in the most healthy places that can be found, provided always that such selections are compatible with the requirements of the service. Elevation and dryness of locality, free from exposure to strong atmospheric currents from the land or sea, may be looked on as two most important requisites for a barrack or hospital site. In the land service, a large amount of the mortality in the tropical, and even in the temperate zone, may be fairly attributed to the swampy and ill-drained condition of the localities where barracks, hospitals, and military stations have been established. In India I have known a station selected for a regiment of dragoons, where the Government, after going to great expense in constructing barracks, hospitals, and stables, and allowing the regiment to bury twice its average strength in the course of twelve years, ordered the locality to be abandoned and the buildings destroyed. So at sea, much of the sickness that has decimated ships crews in the West and East Indies, and on the shores of Africa, may be accounted for by the miasmatic emanations given off from the accumulated filth of the ship's bottom. Such emanations are doubly vigorous in poisoning the systemic blood, and producing fevers of the most fatal type, when on shipboard the air is imperfectly renewed from above, or in land-locked situations where the atmosphere is stagnant. It is vitally important, therefore, that before any permanent station, hospitals, or barracks for troops be established, measures should be taken for obtaining full topo-

graphical information as to the salubrity of the locality, with the physical qualities of the climate and water; and what influence they usually exert on the health of man and animals.

The ground on which such buildings are placed, whether flat or elevated, should be thoroughly drained. The removal of the surface drainage and animal excreta is more important in the tropical than in the temperate zone; as the decomposition of animal and vegetable organic matter in the soil is rapidly promoted by the influence of high temperature, and becomes a most powerful source of morbid agency. An efficient system of drainage and building is capable of completely altering the unhealthy character of swampy localities: so that Bombay and Demerara, once in as bad repute as the shores of Africa, but now drained and covered with buildings, rank among the healthiest of our tropical colonies.* The beneficial results that have followed from quartering the white troops in Jamaica at Maroon Town and Newcastle, where the ratio of mortality is from 2 to 3 per cent., instead of at Port Antonio, Montego Bay, and Up-Park Camp, where it exceeded 14 per cent., are facts patent to all.

Two of the most important points to be attended to in connection with barracks, hospitals, and huts, are to avoid over-crowding, and to obtain proper ventilation. The first object may be attained by building rooms of a proper size and height, and by allotting them, not according to the superficial extent of the flooring, but according to the cubic contents. Sarlandiere, in his *Military Surgeon's Vade Mecum*, urges that not less than 1307 cubic feet should be allowed for each man; but we fear that this ample space will never be allowed to soldiers, either in barracks or hospitals. Our prison inspectors allow 1000 cubic feet for each prisoner, and Tredgold on Ventilation deems 600 to be necessary for the preservation of health. The medium of these two quantities, or 800 feet, should be adopted as the minimum for temperate climates, and 1000 for that of tropical ones. A large amount of disease among soldiers is justly

* The unhealthiness of some of the East India barrack sites, as those of Colaba and Secunderabad, from retention of the surface drainage, is well known. But to the credit of the Directors of the East India Company, it must be said that they have ordered all barrack buildings for the future to be raised on arches.

attributable to the continuous breathing of the vitiated atmosphere of over-crowded barracks, hospitals, and huts; and Colonel Tulloch, in his Statistical Reports of the British Army, has shown that crowded barrack rooms, in tropical climates, are not less influential than restriction to salt diet, in producing increased mortality from consumptive diseases.

In regard to ventilation, after all that has been written and recommended by Dr. Reid and others on this subject, the main object to be obtained is a free circulation of air around the building, so that it may be preserved from damp, and be entirely isolated from other buildings.

On the subject of *duties, exercise, amusements, and education*, my remarks must now be very brief; having already occupied so much of your time and patience. Night duty, particularly in tropical climates, should be reduced as much as possible, so that soldiers should have at least four nights in bed; for otherwise, and particularly when they are exposed, even in climates of the temperate zone, to cold and wet in the trenches during a siege, their health will invariably suffer.

Under the head of *exercise* may be included parades, drills, and marches; and no more fertile source of predisposition to disease exists than in the excess of any of these objects,—beyond the physical capabilities of the soldier. Doubtless, long marching in warm climates has been often overdone, so as to render men generally the victims of cholera and tropical fever; and in no part of the military economy of regiments, or armies, may the sound judgment of commanding officers be more usefully displayed, than in the proper regulation of marching or other exercise for the soldiers.

I will not at present enlarge on the amusements, education, and punishment of soldiers; but, in reference to the whole subject, shall conclude by the following medico-military recommendations, promulgated at Burgos, in May, 1823—when the French army was advancing into Spain.

1. The soldiers always to wear their cloth trousers during the prevalence of cold weather.
2. Not to be permitted to undress on arriving at the halting-place, or at their bivouac in the evening.

3. To wear their over-coats whenever the air is chilly, and when they are not on the march or working.

4. In wet weather, to halt for the night on ground a little elevated, sloping, and sheltered from the wind.

5. To increase in such cases the number of fires, and to keep them up till the time of starting.

6. In wet weather to make a distribution of brandy on starting and on arriving at the bivouac.

7. In hot weather, to march the troops early in the morning, or in the evening, resting during the middle of the day in sheltered places.

8. When linen trousers are permitted to be worn, to make the soldier put on a girdle of cloth or woollen stuff round the belly.

9. To make frequent halts, selecting places where the water is good; and to take care that the men do not drink cold water when greatly over-heated.

10. To give them regular exercise when in cantonments.

11. To be careful that their clothes and shoes are kept up and repaired.

12. When compelled to use bad water, to mix a little vinegar or brandy with it.

13. In marshy places, to encamp, if possible, on high ground.

I have thus imperfectly endeavoured to apply the principles and means of medical geography to the preservation of the health and efficiency of our soldiers in foreign climates. But in regard to the removal of men from one climate to another, their regimen, dress, dwellings, and drill-exercises, statistical results are yet to be collected, and made useful, as the foundation of practical deductions, for our future guidance in everything relating to the British army and navy, as well as the East Indian armies.

July 10th, 1857.

COLONEL THE HONOURABLE JAMES LINDSAY in the Chair.

ON THE RIFLE ; SHOWING THE NECESSITY FOR ITS
INTRODUCTION AS A UNIVERSAL INFANTRY
WEAPON.

Being the substance of a Lecture delivered at the United Service Institution, by LIEUT.-COLONEL WILFORD, Chief Instructor, School of Musketry.

Mr. Chairman, Gentlemen, and Soldiers,

I am permitted to address you on the subject of Musketry, and I shall—

- 1st. Endeavour to show the necessity for the introduction of the Rifle as a universal infantry weapon.
- 2d. The mode by which it is now being introduced into the British Army.
- 3d. The advantages which must ensue therefrom.
- 4th. I shall advert to some objections urged against it.

Although my subject trenches upon the history of arms, the theory of gunnery, and military education, and knowing that it is too comprehensive and important to be properly dealt with in a single lecture, I must crave your indulgence, and I shall endeavour to be brief.

1st. As to the necessity for the rifle as a universal infantry weapon :

Before proceeding, I must pay a tribute to "Brown Bess," and willingly confess that it was a very formidable weapon at *short* ranges, owing to the steadiness of the British soldier when under fire, using such a heavy gun, large charge, and ball. Its deadly fire in close combat, in the Peninsula, at Waterloo, and in India, has been borne honourable testimony to, by those against whom it was directed. Nevertheless, partiality must not be suffered to blind us to the defects of our old friend ; for, with the bayonet fixed, it was the

shortest gun used by any European army; at the same time the *heaviest*; it had the *most windage*—fired the *largest* charge of *powder*—it had the *greatest* recoil—the *least* accuracy. It was folly to attempt to fire with it against small, or at all distant, objects; and the British soldier found himself almost powerless when contending with *half-clad savages* or *semi-civilised* enemies. Beyond 80 yards it lost *all* certainty of hitting a *single* man, at 200 yards it was uncertain even at larger bodies, and when screwed into a block or fired off a rest, you might shoot *all day* at a target 300 yards distance, and 18 feet square, and *never* strike it *once*; so that a man might be in *perfect security* if fired at from sunrise to sunset, at even a less distance than 300 yards, provided the firer made a faithful promise *always to aim at him*. How, then, I may be asked, were our former victories gained? Truly: British infantry have nobly played their part in gaining victories over enemies who were armed with muskets *nearly as bad* as their own; they conquered *with* Brown Bess, not *through* Brown Bess; but rather, they earned honours in spite of it. The late Lieutenant-General Sir George Cathcart, upon whom lay the onus of the Caffre war, wrote to be furnished with such means as, in his judgment, might bring that inglorious transaction to a close, and cut short the Caffre Bill. What do you think he asked for, gentlemen? Three thousand Swiss! Did this English General think Swiss more brave or better disciplined than Britons?—himself pronounced by our gracious Sovereign to be a hero, of a family of heroes! Did he intend to disparage those, his brother soldiers, whom he had the honour to command? Most assuredly not: but he felt a vacuum England's army could not fill,—Switzerland and the Tyrol being the only two countries which could supply the kind of soldiers he required, viz. such as could fire at *small objects with accuracy at long ranges*. On one occasion at the Cape, it was calculated that after firing 80,000 rounds, 25 Caffres were killed, being in the proportion of one Caffre for each 3,200 rounds; and the probability of hitting a man at 500 yards, is as one farthing to 800 millions of pounds,—the National Debt of Great Britain! All men have a way in which they prefer fighting, and Caffres rarely select a piece of open country to try a little bayonet work; so that, unless they can be hunted

like hyenas, war with them may last for ever! What a melancholy object does a civilised soldier present, when loaded like a mule, and armed with a gun which will throw a ball with some certainty about the distance a man can throw a stone, pursuing an enemy who carries little more than his skin upon his back, and to whom every rock and tree is a fortress! In a pamphlet by Colonel Jacob, "Bombay Artillery," he says:—"Man has been called a tool-making animal; and it is a certain mark of advancing civilisation, of the progress of mind over matter, of the development and operation of those laws by which the working of the human brain makes the force of one civilised man equal to that of the stalwart limbs of thousands, or even millions, of untaught and ignorant barbarians. To no people on earth have tools and machinery been of more importance than to the English. It has been said that it was the spinning machinery of Arkwright which enabled England so long to stand alone, and successfully, against the world in arms. If such be the value of the tools employed in the arts of peace, those used in war must be even of more consequence. The military art, like all others, can only approach towards perfection by the use of the most perfect tools and machinery attainable. Yet, notwithstanding this certain truth, it is notorious that the inferiority of the arms used by modern English soldiers was, for long, a disgrace to the intelligence of the age, and an outrage on common sense, when compared with the high state of perfection to which the manufacture of arms, as of all other tools and machinery, has been brought in England." Until recently we had four battalions of Rifles, and also Canadian, Ceylon, and Cape-mounted Rifle regiments, but their weapon (the Brunswick two-grooved) after most extended experiments at Antwerp in 1844, was deemed to be the worst in Europe. The French had for a long time discontinued rifles in their armies, thinking that the time lost in loading was not compensated for by their comparatively increased accuracy. The inefficiency of the smooth-bore musket is shown in the most marked manner by the number of years it has taken our French allies to subdue the native tribes of Algeria, as fighting may be said to have just closed there after about 30 years' duration. The French, finding themselves unequally matched against Arabs and

Kabyles, who had a range and accuracy unknown to the French infantry, attempted to place themselves upon equal footing, by carrying wall pieces (the hand-gun of 400 years ago), and afterwards they sought to effect their purpose with light artillery; but these not proving satisfactory, they turned their attention back to the rifle. The French army now includes some thousands of chasseurs armed with rifles, and I believe that the expense is the only bar to their universal introduction, as they happen to have in use and in store some 700,000 smooth-bore muskets. Fortunately we have not our neighbours' difficulty to contend with, as between 200,000 and 300,000 Brown Besses were burnt to a cinder one fine morning, with other rubbish and cobwebs, in the Tower. I hope the quarters where naughty people were placed in former times were burnt down at the same time, lest some one I know should be thought worthy of incarceration. The Prussians have many thousands of their infantry armed with a breach-loading long-range rifle. The Russian army is to have 54 rifle regiments, with a rifle company to each other regiment of infantry. The Austrians are busy at work, according to their means. The Tyrol has always supplied them with a large number of marksmen. The Belgians are, I believe, universally armed with rifles; and even the little kingdom of Portugal has ordered 28,000 rifles from Belgium. Thus, whether we shall universally arm with a rifle or not, seems to have been settled for us by their adoption into foreign armies, as we must either place ourselves upon an equality, as to armament, with those against whom we may have to contend, or lie down in the gutter, content to allow our enemies to ride over our heads roughshod! I shall now describe, by way of contrast, the performances of the Enfield rifle. It is $2\frac{1}{2}$ lbs. lighter than the old musket, has a smaller bore, fires a heavier projectile, it is stronger, has only .009 windage, uses only $2\frac{1}{2}$ drams of powder, has little or no recoil, and it is sighted up to 900 yards. It can be loaded with the celerity of any smooth-bore, but possesses an accuracy far beyond what Brown Bess or the Brunswick rifle could attain. An experiment was made at Hythe, in which 35 men, skirmishing in marching order, fired 30 rounds each, advancing and retiring at distances between 820 and 550 yards, at two targets, the one 50 yards in rear of the other, each

having a frontage of 30 yards, equivalent to 35 files: the targets were six feet in height, and the distance between the two was equal to that of a battalion column at quarter distance. There were 617 hits out of the 1,050 rounds—the men engaged had to judge their own distance. Had there been six intermediate targets to represent the other companies, it is not too much to suppose that they would have had at least 200 more hits; so that, out of the 1,050 rounds, about 800 would have told upon the column. On another occasion, 30 men were arranged in skirmishing order, and fired at a group representing a fieldpiece coming into action (stuffed figures of horses and men of the ordinary size); the firing was stopped at two minutes, when it was found that each man had fired two rounds; when of the six horses and eleven men, including the three mounted drivers, the six horses had twenty-two balls in them, and seven of the men were also struck. This trial was repeated at 815 yards; five out of the six horses had sixteen hits, and six out of the eleven men had eight balls! At this second trial the time was extended to three minutes, when it was found that the front rank had fired three rounds, and the rear rank two. Had one rank not waited for another, but had both fired together, the same execution would in each case have been done in half the time. In volleys at a frontage representing a section of a company—targets six feet high; at 300 yards, 90 per cent. hits; at 400 yards, 76 per cent.; at 600 yards, 52 per cent.; and at 800 yards, 25 per cent., were obtained by soldiers who had only undergone one course of instruction at the School of Musketry. At individual firing the results are equally surprising: an officer of the 1st West India Regiment recently hit the target seven times out of eight consecutive shots, three of which were fired at 850 yards, and five at 900 yards.

But the rifle invented by Mr. Whitworth (and which has been tried at Hythe) as far outstrips the Enfield, as the Enfield does the Brunswick; and experiments are now in progress at Woolwich, to see how far it may prove suitable for a military arm, and more fully to test its merits. Opinions are more or less valuable according to circumstances, but facts are stubborn things, and, if killing your adversary be any test of a gun, there cannot be much difficulty in determining the comparative merits of any arm. The Whitworth

will fire better at 800 yards than the Enfield at 500: beyond 1,100 the Enfield must "cease firing," while Whitworth's can do business at 2,000! Indeed, rifling seems to be in its infancy, and range must only stop, with the powers of the human eye to take an aim. Breach-loading rifles have also been invented, from which there is not the slightest escape of gas, and which can fire ten rounds in one minute. The continuance of their fire will only be restrained by the exhaustion of their ammunition, or the rifle becoming too hot to hold.

Allow me to read an extract from a recent number of the Times, as follows:—"What is a Rifleman? He is simply an infantry soldier, equipped with a fire-arm, and therefore differs nothing, upon a first presumption, from any other soldier in the line. But his equipment differs in quality, if not in kind. His weapon is constructed especially for long and accurate shots, and he is trained to manœuvres, teaching him how to improve every advantage of ground or position which he can find. That in these respects he may be better than an ordinary soldier is very true, but why need the ordinary soldier be left in this position of inferiority? Why should not every soldier in the line be provided with a firelock as good as can be manufactured, and taught to use it as cleverly as a sharpshooter? A rifleman, after all, is nothing more than a musketeer, armed with a musket which will kill, and one musket ought to do this as well as another. Take a parallel from times long past, when the favorite weapon with the Englishman was the bow. We do not read in those days of any company of archers provided with particularly good bows or arrows, or expected to shoot with particular accuracy. Every man had as good a weapon as could be found, and endeavoured to use it as well as his neighbour. If, in an army of 100,000 musketeers, 10,000 can hit the mark, while the others cannot, they become of course a corps of peculiar utility; but their superiority would vanish when the other 90,000 became marksmen of equal merit. If the rifle, or effective musket—for the rifle is nothing else—were ill-adapted to general service, it would be another matter; and, as every man alike carries a firearm as his weapon, there can be no reason why one

"should not be as well equipped and as well trained as another,—
"why the greatest available efficiency should not be imparted
"to all. In our opinion, it is better to make every soldier in the
"army a good shot, than to assume that most of them will be
"bad ones, and provide special battalions for compensating the
"defect. In this respect, every battalion should be special, and to
"such an end we hope our own organization is now tending." I
confess that I entirely concur in the sentiments contained in the
foregoing quotation, and happily our rulers have determined that
every British soldier shall be "*special*," and a rifleman. Thus we,
having the kernel, need not trouble ourselves about the shell,—so
that whether some regiments shall have short rifles, and long swords
to interfere with their running, or longer rifles and short bayonets,
does not much matter. If for "*auld lang syne*" the most con-
spicuous colour, viz. black, be preferred by some, let them wear it.
Riflemen can only be made such by teaching,—they are not born
such, though some learn quicker than others. In the English army,
a soldier cannot be made to serve in any regiment contrary to his
own will; and to extract the good shots from one regiment and
place them in another, *vice* an equal number, whose *only* fault was
that they could not shoot, would be submitted to by the colonel
about as gracefully, as if you were to extract a tooth a-morning,
till all were gone, and furnish him with a pretty, white, new set
with which he could not masticate. Happily, no English colonel
will ever be called upon to command a *weeded* regiment.

Thus, I trust I have shown the necessity for the introduction of
the rifle as a universal infantry weapon: first, from the insufficiency
of the old musket; secondly, because foreign armies are largely
introducing it; thirdly, from the astonishing powers of the rifle in
the hands of a *taught* soldier.

2ndly. Before proceeding to show the mode by which the rifle is
now being introduced into the British army, I shall briefly refer to
the manner in which firing was taught hitherto;—and here, strange
as it may sound, although the name musketeer implies a soldier
who destroys his enemies by firing out of a musket, and sticking with
a bayonet, yet how to perform these with the greatest effect were
the *very two* things he was never taught. Being placed in position

to commence firing or to charge, the soldier was left to his own resources; virtually, in firing, he shut his eyes, opened his mouth, threw his head back, and pulled the trigger; and, as if this was not enough, he was sometimes exhorted to "aim low." His feeling commander, being so supremely ignorant, might just as well have said: "You see those poor fellows?—do not hurt them—aim low!" an almost certain mode to insure their balls flying over the heads of their opponents, as any ball will ricochet at the same angle with which it strikes the ground. There was a *thing* called ball practice; it was looked upon by all parties as a bore, hurried through as a form, almost universally, as there were but very few bright exceptions, being the infinitesimal minority of officers, who thought their men were intended to hit when they fired off balls! How can anything be practised which has not been *previously* taught? Ask a man to practise the fiddle, who does not know a note; or to dance a polka, who has never been taught a step. Hence our ball practice was, in most cases, little better than a farce, and if the calico target did not look sufficiently satisfactory to be carried in triumph into the barrack yard, the drummer well knew that he had only to drive a few holes through it with his drumstick to make it "all right." It is true that the "Infantry Manual" contained most valuable instructions for firing, but these were almost a dead letter for want of detail, while it must be admitted that, from the wretchedness of the gun, it would not have paid for the trouble of teaching; although, had the instructions been complied with, firing would certainly have been much better than it was. Our new gun requires a new man; as Colonel Jacob says, "a skilled workman, not a pipe-layed automaton." With this view, the late Lord Hardinge, who introduced the Enfield rifle, established in 1858 a normal school of musketry at Hythe, in order to qualify the soldier to use it. Detachments of different regiments are sent to that establishment to go through a course of training, which occupies about ten weeks, in order that each regiment may be supplied with a qualified officer and non-commissioned officer instructor in musketry. The instruction is divided into theoretical and practical—the latter into drill and practice. The object of theory is to give the reasons for everything that the soldier may be afterwards called upon to perform in

practice; and it is taught by lectures, diagrams, models, and by catechising. There are four drills, viz., cleaning of arms, target drill, judging of distance drill, and the manufacture of cartridges; target drill being divided into aiming and position drill. The most minute attention is paid to each individual soldier, and he is taught to fire in *drill*, balls being afterwards used in practice merely as a test of the soldier's proficiency. A man cannot be made to hit a mark against his will, in fact, he fires with his brains, the eye and finger being merely servants of the mind. To succeed or to excel, there must be love in the heart and knowledge in the head, but no man can be interested in that which he cannot understand. Hence, each soldier is made to comprehend the laws which influence the bullet in its flight, and how to apply this knowledge to practice. He is led to think, and his moral character is found to be improved and elevated thereby. He becomes conscious of his increased efficiency and value; he is raised from a mere machine—a trigger-puller—a thrower away of fire—and, after instruction, is not merely a good, but an intelligent shot. It has been satisfactorily proved, that taught soldiers beat untaught officers, but taught officers will excel taught soldiers. A regiment, on the old system, never improved, year after year, in firing ball, while a taught regiment fires better each succeeding year. Sportsmen are generally beaten by taught men; to their annoyance and surprise, they cannot hit an iron target, but refer to their performances at bogs in Ireland, or jungles in India. The officers are put through precisely the same amount of drill and practice as the private soldier, each snapping caps, firing twenty rounds of blank, and 110 rounds of ball, in individual firing, file and volley firing, and skirmishing, in which they are exercised as soldiers; but in addition (being attached to sections and classes, when they act as officers) they are taught *how to teach*. A series of lectures, eight in number, is delivered and explained to them, upon which, and upon the whole course of instruction, they are catechised and examined in presence of the commandant, at the expiration of the term, preparatory to receiving certificates. The eight lectures treat of the theory of gunnery, the history of small arms, the history, manufacture, and explosive force of gunpowder; of these each officer is required to take a copy.

Thus in each regiment of the line it is intended that there should be at least one intelligent officer, possessing a fund of most important information connected with the efficiency of a rifle regiment, and to whom is entrusted the duty of aiding his commanding officer in furthering the efficiency of his regiment, by instructing the officers and men in the theory and practice of musketry. I trust I have sufficiently pointed out the mode by which the rifle is being introduced into the British service.

3rdly. As to the results which must ensue.

Actual and varied warfare can alone fully demonstrate the consequences of war carried on with such amazingly increased powers of destruction placed in the hands of the infantry, who have ever been numerically the strongest portion of modern armies; and it will depend upon the talent of commanders to avail themselves fully of these powers. Unquestionably the whole system of tactics and fortifications must undergo important modifications, from the altered relative value of artillery, cavalry, and infantry. I shall not presume to dictate how our new infantry shall be best employed, but I can state what their powers *will* be. My duties lead me to deal with units, whose value becoming increased in proportion to the amount of instruction, we arrive at sections, companies, regiments, brigades, and divisions, until the whole infantry of our army can shoot at long ranges. Should two rival armies take up their position at a very short distance, and choose to take issue with the bayonet, in this case, a pike might answer all purposes even as well as a musket, much less a rifle. But the long-range rifle will tend to keep armies at a more respectful distance. Unquestionably in all the minor operations of war, in desultory warfare, in the defence of posts and field works, in clearing out embrasures, mantelets and gabions being fired through, the lines of defence in permanent works being lengthened, infantry rendered less dependent for support upon artillery, advancing columns and field batteries being reached at 1,000 yards, and thus be for a long time under a destructive fire,—in all these cases the rifle will play a most important part. A taught regiment of 800 men could throw 16,000 bullets in ten minutes into a fort of an area of 50 square

yards, at a distance of 900 yards; and this could be done over the heads of a column advancing to storm. With such startling facts, showing the mighty change which must take place owing to the efficiency of infantry, one cannot but be surprised at the silly, indeed the almost rancorous, spirit of controversy, with which the introduction of the rifle is attempted to be opposed. One might almost suppose, in treating of the powers of our weapon, that we are longing for a tilt against our artillery brothers on Woolwich Common, while all the time we are only thinking of making short work with our Queen's enemies. Every patriot cannot but rejoice on finding that there are improved means of securing the duration of peace, and curtailing the evils of war; whether it be by improving the sabres or lances for our dragoons, the ships and armament of our navy, the guns of our artillery, or by the rifles of our infantry and marines. It is well that each branch of our service should be "well up" to what is going on in the others; and as foreign nations are "wide awake," our artillery and dragoons may as well "look out for squalls," for they may safely anticipate a brush with long-range accurately-shooting infantry. It is too late to deny facts; and to "go a-head" is doubtless the order of the day with each and all of us. The English army must ever be a small one; our object therefore should be, to make up by efficiency for what we want in numbers. While no expense should be spared in perfecting our arms and ammunition, so, also, too much pains cannot be taken to qualify the soldier effectively to use his improved weapons, ever remembering that the good gun is worse than useless in the hands of an untaught man. It is right to have a sufficient supply of first-rate rifles in store, but if we trust to them for safety, not knowing where to find intelligent men to use them, we are leaning upon a broken reed; it is not to the weapon, *but to the user of it*, we must trust for the protection of our throne, our altars, and our hearths! Was it English bows that gained immortal honours for English infantry at Cressy, at Poitiers, or at Agincourt? No, it was English *bowmen*. Were slings from the Balearic Islands better than those made at Rome? No, but the *slingers* were. John Bull consoles himself by knowing that "wooden walls" surround his "sea-girt isle," but for myself, my

gratulation increases when I hear about the "hearts of oak" to stand behind those walls. Some weeks since our friend John was assured that there should be no needless call upon his pocket, as the line was pared down to the ante-war standard, but that there should be lots of rifles in the stores, and large numbers of militia (at their ploughs), who at the end of three weeks could be made perfect soldiers, and fit to be employed for the defence of Mrs. and the Misses Bull. If by a soldier is meant a man in red, who can march without treading down the shoe-heels of one in front, well and good; but if you mean to convey the idea of one skilled in the use of a rifle, perhaps three years would be nearer the mark. The maximum of efficiency, with the minimum of instruction, could be best got out of a pike, a weapon one stage a-head of the broom-stick, and the one I would recommend to be placed in the hands of your three-weeks' men. Although my opinion as to the consequences which must ensue from the introduction of the rifle can have no weight, I am fortunate in being enabled to refer you to the opinions of officers of artillery. Colonel Jacob, to whom I have before alluded, writes:—"Judging from our practice, it seems certain that two good riflemen so armed could in ten minutes annihilate the best field battery of artillery now existing." "The army which should first adopt these weapons would thereby obtain an advantage equal to that of the exclusive possession of fire-arms a century ago. One effect of these would be that the whole of our field artillery would become totally useless." "Train and arm the men worthy of their noble nature, and 50,000 such soldiers would be a match for a world in arms." "Any numbers or mere masses of semi-barbarous enemies, aye, or of ordinary soldiers, would be powerless against such foes. Cavalry would become of little value against such infantry, and our present artillery absolutely useless against them. With open files and ranks, each man a skilful combatant, but still all acting in perfect concert, as would be easy with such brave, trusty, and intelligent and skilful men, they would sweep their enemies from the earth, themselves almost unseen; while a single discharge from a company at 1,000 yards distance would annihilate the best field battery now existing. The value of individual skill and

“ practice would be immensely greater than under the present
“ (1855) system. No amount of mere ‘food for powder’ could
“ successfully oppose even a small force so formed; opposition to
“ the English soldier would become as impertinent on land as it
“ has been said to be by a celebrated French author to our seamen
“ on the ocean. With such infantry so armed our artillery must
“ be abolished or improved.”

I shall now read to you a few extracts from a work, entitled
“ *Constitution Militaire de la France*,” written by Paixhan, a General
of French artillery, and translated into English by Major-General
Brereton, Royal Artillery. “ Napoleon has said that the musket
“ is the best warlike machine invented by man; what would he
“ have said if he had seen the new arm? What the consequences
“ of this change will be, it becomes of importance to examine.
“ At 600 metres the enemy’s case shot will scarcely range, and his
“ round shot will only hit a group of two or three men six times
“ out of 100 rounds, but at that distance our infantry can make
“ every shot tell upon the vast group of men and horses in action
“ with a gun. The enemy’s artillery must soon be silenced. Thus,
“ on both sides, if a battery of artillery be placed in line, and in
“ advance, and if a company of light infantry be placed in front of
“ it, there will probably be a complete extinction of fire of artillery.
“ No doubt the cannon will always retain its superiority in pene-
“ trating deeply into the heads of columns, in clearing obstacles,
“ and in acting at considerable distances; but the fire of light
“ infantry will have a terrible effect against field batteries; and a
“ swarm of light infantry upon the whole line, firing with such
“ exactness, what will not be its effect upon an enemy’s troops,
“ upon its masses, and upon its officers, who will be selected as
“ objects by the most practised of the marksmen? Doubtless,
“ the more effectual an arm has been rendered, the more skilful
“ should be the man who is to use it. Thus this new arm—a
“ French invention—will not only be favourable to France, but
“ also to all defence against attack; it will be in favour of the
“ weak against the powerful; favourable to independence, to the
“ rights, to the peace, and the dearest interest of every nation.
“ Now that the musket has been rendered capable of striking a

"group of two or three men six times out of 100 rounds at a distance of a quarter of a league, and that at 200 metres every shot takes effect, it is evident that constant firing, and more especially the meeting of line against line, column against column, will become less frequent—that a change will take place in battles and manœuvres." I trust, gentlemen, from what I have now stated and read, that you are satisfied that most important alterations and consequences *must* ensue from the adoption of the rifle musket as an infantry arm, bearing in mind that those intelligent artillery officers, when they wrote, were entirely ignorant of the *vastly increased powers* of the Whitworth rifle.

4thly. I shall now notice some of the objections which have been used against the rifle as a universal infantry weapon. Although it is only six years since the introduction of the Minié, and four since the Enfield, much of the outcry, and many of the objections, have died out; and, indeed, they were most of them so puerile, as hardly to deserve the time taken to repeat them; to answer such "twaddle" would be worse than waste of time. "Rats and mice were to eat the grease of our cartridges!" "The hole made in a man's body by the bullet would be too small!" "The soldiers would forget to reverse their cartridges from excess of funk!" "They would not be able to judge the distance of the objects." "Courage would vanish by firing at long ranges" (ergo, the rifles and artillery must be cowards *par excellence*). "Squatting on the heel would spoil a man for charging." "Position drill would make a battalion shaky under arms." It is in print, that infantry soldiers were never intended to play at "long bowls;" "it is not their business to shoot men a long way off." They must not poach on the manor of a man dressed in blue, with scarlet facings; and, until recently, it was not lawful for a man dressed in scarlet, with blue facings, to shoot an enemy unless with a bullet of spherical form, weight one ounce, powder $4\frac{1}{2}$ drams; and the projectile must "not be a compound," but be made of lead only. "The rifle is too delicate, and not fit to be put into the hands of a common soldier;" wilfully forgetting that that master mind, the late Lord Hardinge, who placed the Enfield rifle in the soldier's hands, also established the school of musketry, that he might be qualified to use the *best gun which has ever yet*

been supplied in such large numbers to any army that ever trod the earth; and every Briton owes a deep debt of gratitude to that great man, who, ahead of his generation, ardently longed that before he died, the English soldier should carry the *best gun that could be made*. But, gentlemen, we do not intend to have a "common" soldier; and I need only point you to the gallery, crowded with infantry soldiers of the Guards, to prove that our men can be interested in their profession, and are willing to be instructed. Let no one dare reproach a soldier with being "common" or ignorant, until he himself shall have used every exertion in his power to enlighten and to make him uncommon: perhaps he is more ready to learn than we are to teach. By calling the rifle "delicate," an aspersion is cast upon the character and judgment of Lord Hardinge, who decided that it was entirely suitable for military purposes. If I knew what was meant by the word "delicate," as applied to the rifle, I should be glad to answer the objection. If fragile or weak is intended, I have authority for stating that, although lighter, it is in reality stronger than "Brown Bess." Perhaps delicacy may refer to the construction or use of the sights. I can only say that I have witnessed the firing of hundreds of thousands of ball cartridges, by all sorts of men, and have never seen but one injured, and that so very slightly, that its use was not in the least interfered with. It is foretold that the infantry soldier will be too much alarmed, from the fire of artillery, to use his sight; but permit me to remind this objector, that artillery can only fire with accuracy from being a judge of the distance, and then by using a sight; and that they are equally subject to fright, being the recipients of a shower of leaden hail, while pouring forth their thunder. A back sight is quite a proper thing for a large gun, fired by a man in blue, but wholly unsuitable for a small gun, and beyond the care and capacity of his brother in yellow facings! This is almost too absurd! A chronometer is, I believe, a most delicate instrument; but I never yet heard that it is too delicate for a sailor. The promised advantages are said to be "overdrawn," and a wise man recently wrote in the Times, that this was proved by the few Russian dragoons who were unhorsed by the rifles of the 93d Regiment at Balaklava. Now, a taught soldier is not in

the least surprised on account of this total failure; but his astonishment would rather have been called forth, had the results been different. Would a gold pen, value 15*s.*, write when placed in the hands of little Tommy Hodge, he never having been previously instructed in the formation of "pot-hooks and hangers"?

Mr. Chairman, Gentlemen, and Soldiers, I shall trespass upon your time no longer: permit me to thank you for the patience and fortitude with which you have endured my long-range skirmishing. I fully believe there is a glorious door open for British infantry. I trust that our comrades who have recently gone to India have had some measure of rifle instruction, and that they may give a taste of the Queen's lead to those demons in human form who have eaten the Queen's salt. May the number of officers who are pursuing the army as a profession be daily on the increase, and largely predominate over those who endure it as a calling. May our gracious Sovereign have always at her disposal fifty thousand adepts in the use of the rifle—and, under the fostering care of our Royal Commander-in-chief, may British infantry become as renowned for skill as they have ever been for valour; and may they reap wreaths of laurels with their bullets, to intertwine with those which they have gathered with their bayonets!

July 17th, 1857.

LIEUT.-COL. T. ST. LEGER ALCOCK in the Chair.

ON MILITARY TACTICS.

By LIEUT. D. C. WALKER, R.E.

HISTORICAL DEVELOPMENT OF MILITARY TACTICS.

THE earliest mention of combined military operations is contained in the Homeric poems; previous to that time, war can have been little else than a succession of predatory inroads. Yet no common band of discipline united the Greeks under the walls of Troy; each

of the chieftains contributed his band of followers to the common cause, and one of their number was chosen as commander-in-chief. His authority, however, was by no means paramount; indeed he was little more than president of the council of generals that was convened on all important occasions. Nothing like the tactics of a regularly disciplined army is to be traced in Homer's descriptions of battles, which were singularly indecisive in their results; they appear to have taken place constantly, even daily, before the city. The rival chiefs, carried in chariots and clothed from head to foot in defensive armour, met, challenged one another, and fought, and, if one was slain, a victory was considered to have been gained. The mass of their retainers, composing the infantry, was lightly estimated, and but little reliance placed on them. Cavalry was unknown. Thus individual prowess was everything, and the age has been well termed "the Heroic!" As time advanced, however, popular influence increased in the states of Greece; democracies arose; and this change in the civil constitution induced a corresponding one in the military. It was no longer the few mail-clad heroes that decided the victory, but the steady, compact, disciplined *mass*, actuated by the mind and moving at the command of one man. The celebrated Phalanx was the feature that characterised the tactics of this period. It was a mass of men armed with shields and pikes twenty or more feet in length, arranged in ranks in compact array, and led by a variable proportion of officers. These were most carefully distributed in the different parts of the Phalanx, according to their courage, skill, or other military qualities. The strength of the Phalanx lay in the irresistible force with which it bore down in a charge, and the firmness with which it received one; but it changed its front with great difficulty, and, if an attack was made on it during the movement, all was lost. Rough or undulating ground too must have caused great confusion in it, and the rigid inflexibility of its tactics rendered it indisposed to the attack of a position that was strengthened by earthworks or stockades. In a battle the conflicting armies were usually drawn up in two parallel lines, and the engagement began at the same time in all parts of the line. Cavalry and light infantry generally accompanied a Phalanx, but the former was misunderstood, and undervalued in consequence. By degrees modifications crept in;

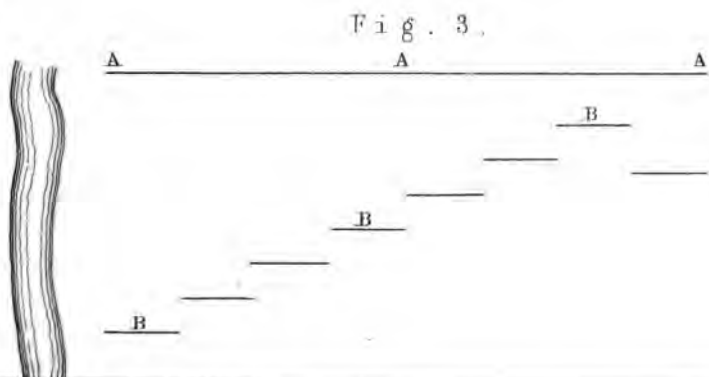
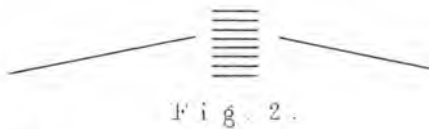
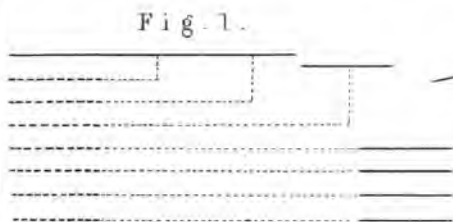
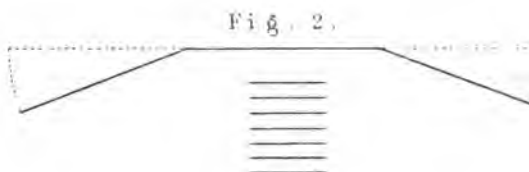
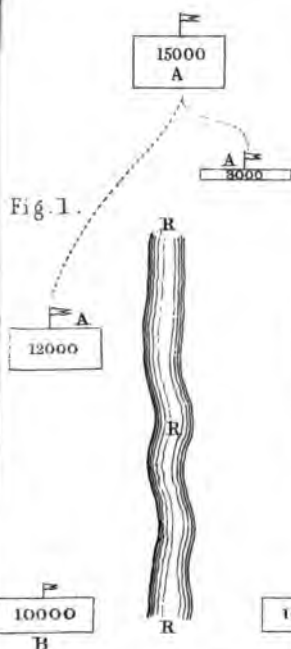
Epaminondas at the battle of Mantinea charged the enemy's line in column and broke it. Alexander the Great introduced a rough species of artillery into his army, which consisted of machines for throwing stones, darts, &c. But the Romans were the first who entirely abandoned the system of the Phalanx, and adopted a new one, viz., that of the Legion. The organization of the Legion was so ably described by Colonel Macdougall in his lecture on the Genius and Campaigns of Hannibal, that I think it unnecessary to detail it on the present occasion. It will be sufficient to recall to your memory, that the Romans drew up their troops in five parallel lines for an engagement; if the front one was defeated, it retired, passed through the intervals of the other four, and re-formed in rear of them; the second then advanced to the attack, and if necessary retired in the same manner, its place being taken by the third line, and so on. The Romans were also celebrated for their invariable practice of intrenching the positions they occupied, and so much attention did they bestow on this branch of military art that each soldier sometimes carried an intrenching tool in addition to his arms and provisions.

It has often been said that "events reproduce themselves in cycles." The stages of advance in military organization appear to have done so in a remarkable degree. After the decline of the Roman Empire as a single all-powerful state, and before the rise of the different kingdoms which grew out of it, the heroic age almost seems to have returned under the name of the Feudal System; victory once more inclined to the side which boasted the greater number of knights in armour, and battles were fought with almost as little regard to a fixed ultimate object as those of the Greeks and Trojans. Military glory appears to have been almost invariably the sole aim of the combatants. The same causes which had led to the decline of the heroic age gradually sapped the feudal system; but in the latter case the transition was far more rapid, because a new and powerful agent, hitherto unknown, at least in Europe, came into action: this was gunpowder. Previous to its invention a man cased in complete armour could drive a host of ill-armed peasants, for of such materials did the retainers of the feudal barons consist, and the moral power which he derived from this superiority was great. It is true that

masses of English bowmen were brought into play towards the close of this period, and threw great weight into the scale of victory; but this was not the case until late in the feudal era, and the disparity between an archer and a knight was not nearly so great as between a knight and a man armed with a fire-lock. Great was the revolution produced by the introduction of fire-arms into war. The fire of masses of infantry became the most powerful weapon for offence or defence in the hands of a general; a bullet found no impediment in a coat of mail, and the use of the lance rapidly declined: the lofty baronial castles came down, and the raised earthen rampart took their place. Nor was the change confined to warfare; the men who were drawn from the plough and loom to form the army in time of war, were conscious that their value had risen immensely, and the feeling of independence they carried to their homes must have excited a powerful influence on their political condition. Standing armies were the next innovation; and the individual efficiency of the soldier, together with the art of moving masses of troops, improved gradually, until Frederick the Great brought the modern system of tactics to the highest state of efficiency.

MODERN TACTICS.

Napoleon defined war in its broad and general sense to be "the art of being the stronger." In what then does the art of being the stronger consist? It consists in placing at a decisive point a greater body of men than the enemy can there oppose to you. This is the fundamental principle on which the art of military tactics depends. But this is not always an easy matter, nor does it follow from this principle that victory must invariably fall to the general who has the greater number of men at his disposal. His position may be intersected by a ravine or wood or other natural obstacle which may impede his lateral movement, whilst that of his opponent is clear. Thus in fig. 1. pl. 1, supposing B to be an army of 20,000 men divided into two portions by a ravine or river R, R, and A an army of 15,000 men in one body, it is evident that the general commanding the army A may leave 8000 men to hold in check one portion of the army B, whilst with the remaining 12,000 he attacks the other; and many other circumstances of a similar nature may and





do occur in actual warfare. It is also evident that an army to obtain the above-mentioned advantage must possess the power of moving and of altering its disposition with facility. Now the handling of 20,000 men is a serious matter; to effect it without confusion, one man must direct its movements; it must be divided into fractions, each directed by a subordinate commander; these fractions again must possess equal facilities of movement, and for this purpose be subdivided into smaller fractions led by a lower grade of officers; and, to crown all, each individual man in the smallest fraction must have been accustomed to stand, to turn, to advance, to retire at the word of command. Thus it appears that finally the efficiency of an army is reduced to the efficiency of the individual soldiers composing it. The art of tactics consists in so employing masses of individuals who have been thus trained implicitly to obey a word of command, and to use the weapons entrusted to them, as best to carry out the great leading principle that large bodies of your troops should be opposed to smaller bodies of the enemy. This is the aim and object of the organisation of modern armies. Modern armies consist of cavalry, infantry, and artillery. First then I shall proceed to consider the leading methods of employing infantry.

Infantry formations are four in number, viz. Skirmishers—the Column—the Line—the Square.

1. *Skirmishers.* The general adoption of this formation of infantry in the armies of modern Europe dates from the French Revolution. The armies of the Republic consisted of hastily assembled levies unaccustomed to war, who had to confront the disciplined armies and systematic tactics of other nations. It was necessary to devise some novel mode of warfare in which to employ the newly raised armies, and such was found in the formation of skirmishers. When a position is to be attacked, a line of skirmishers precedes the main body, and by picking off individuals in the enemy's masses harasses his troops, shakes his line, and weakens the resistance he would have offered to the attack. In retreating in presence of an enemy several lines of skirmishers protect the rear; the rear line fires a few rounds, the skirmishers covering themselves as much as possible by irregularities of the ground, bushes &c. &c., and then retires at the double through the intervals of the others. In march-

ing through a woody or broken country, as was often the case in the Kaffir wars, skirmishers are thrown out in front, in rear, and on the flanks, to give timely notice of the approach of an enemy or an obstacle which might be in the road, such as a stream or ravine, and in an engagement such ground is always occupied by light troops employed as skirmishers. The skirmisher requires presence of mind and self-reliance; he acts to a certain extent independently, and should have a quick eye to seize any irregularity in the ground which may afford him cover, such as a bush, a heap of stones, a mound, a hole, &c.

When attacked by cavalry, skirmishers should run together and form small squares, of 4, 8, or 16 men, by standing back to back.

2. *The Column.* The Column is the formation best suited for the march, on account of its compactness. In action the leading divisions of a column are supported by those in rear, and they again are covered by it. The column has, however, been proved by numerous examples to be unsuited for attack; none but the leading companies can deliver their fire, and, if attacking a line, the column will be exposed to its full fire; at close combat the leading division would be overpowered, and the remainder taken in flank, by the extremities of the line (fig. 2, pl. 1). An attack in column was skilfully repulsed at the Battle of Vimiera by a regiment in line,—the 50th. The regiment, 700 strong, was attacked by a French column of 2,000 men: the colonel changed his front, throwing back the left, against which the attack was directed, and bringing forward the right; then, delivering a volley at pistol shot, he charged, and the column was completely routed in the attempt to deploy (fig. 3, plate 1). If, however, infantry is exposed to attack from cavalry, it must be formed in quarter-distance column, as a square is soonest formed from this order; or, if the charge is sudden, it may even be sustained by a quarter-distance column, as was done by the Austrians at the battle of Aspern.

3. *The Line.* This is in almost all cases the best formation in collision with the enemy, but it should be formed before coming in actual contact with him, as a deployment under fire is a difficult and hazardous movement; each division, as it is in succession uncovered, becomes exposed to the fire of the enemy, and a charge

when the movement is being executed will probably be fatal (see plate 2, fig. 1). The great advantage of the line is that every man in it can use his weapon; but it is much more difficult to move than a column, both because it is less compact, and because the commander has to make his voice heard at a greater distance. When once broken through, a line is divided into two portions, which can be taken in flank and beaten in detail (pl. 2, fig. 2). A line deployed in echelon appears to combine to a great extent the advantages both of the line and column. One flank of an echelon is sufficiently retired to be secured from attack, and, though it may appear that the divisions composing it can be overpowered successively as they come up, yet this is not the case, as may be seen from plate 2, fig. 3, where A is a contiguous line attacked by B, a line deployed in direct echelon. B's left flank is sufficiently retired to be secure, and, if A attempts to bring some of his divisions from his right flank to overpower B's divisions successively, their own flank will be exposed to the fire of B's rear division. If B's left is supported by some natural obstacle, it cannot be attacked at all, and the leading division may be supported at the expense of the retired flank (pl. 2, fig. 3). From what has been said it is evident that the column is the formation best suited to the march; the line to collision with the enemy; and that a line deployed in echelon combines to a great extent the advantages of both. A good instance of the latter point was afforded at the battle of Meanee, where Sir Charles Napier attacked in direct echelon.

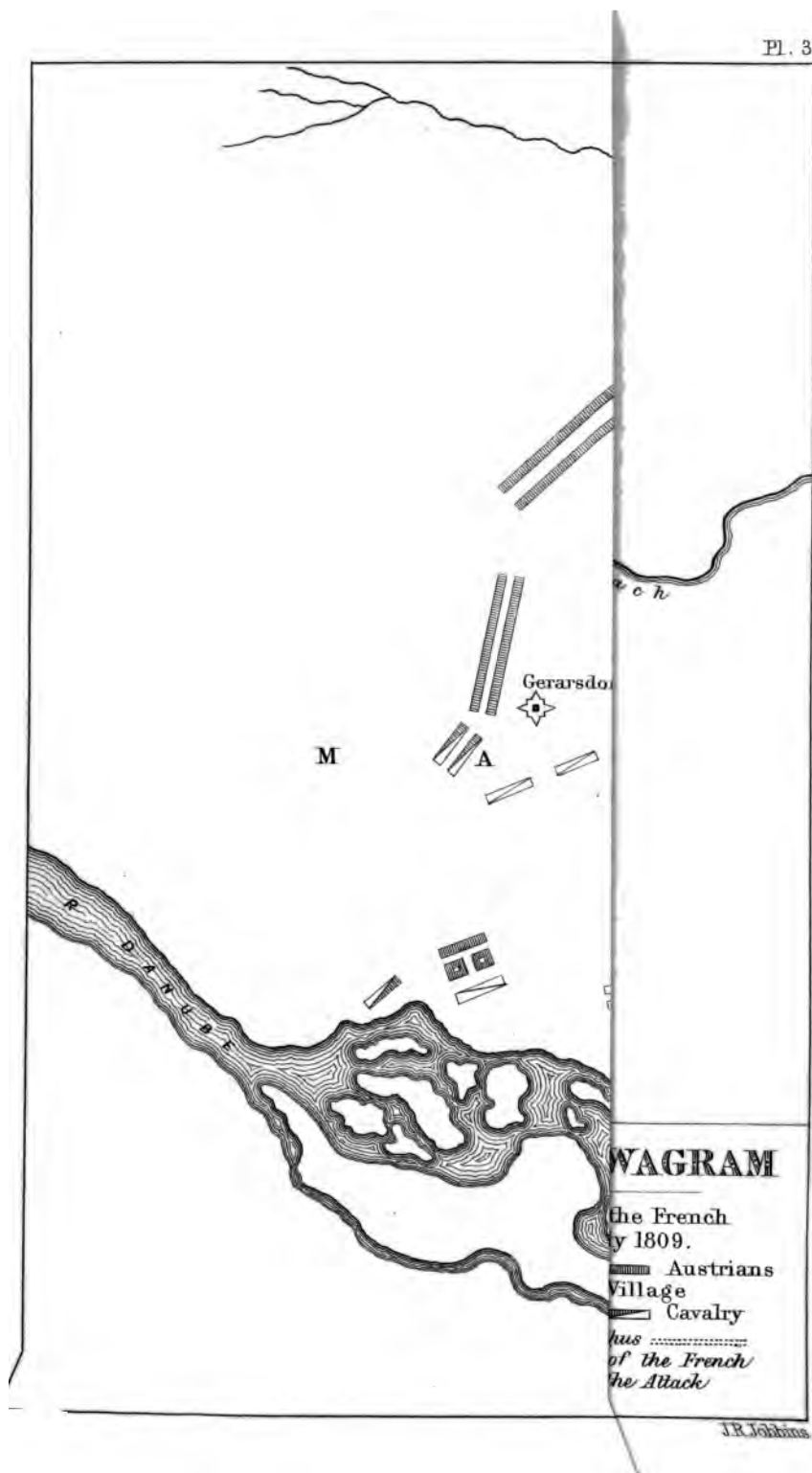
4. *The Square*, as is well known, is employed to resist the attacks of cavalry, and in the British service is formed four files deep. This formation has even been adopted on the march, as in the French campaign in Egypt on the march to Cairo; and during an engagement for purposes of attack, as was done by Marshal Macdonald at the battle of Wagram.

TACTICS OF CAVALRY.

Having briefly considered the chief features in the Tactics of Infantry, I now pass on to those of Cavalry. In all services cavalry is divided into Light and Heavy. Heavy cavalry in the British service is composed of large men, mounted on powerful

horses, and sometimes protected by cuirasses. Their principal use is to break masses of the enemy's troops. The utility of the cuirass has been questioned by some who are undoubted authorities on the subject; they have urged that defensive armour adds greatly to the weight carried by the horse, and unfits cavalry for any other duty than the charge in an engagement, and that the protection it affords the wearer is counterbalanced by its impeding the free use of his limbs and preventing him from injuring his opponent. On the other hand it may be said that heavy cavalry has done good service in every war. Napoleon's far-famed Cuirassiers often turned the scale of victory at a critical moment. At the battle of Borodino, the Russian redoubt, which was the key of their position, after a bloody contest which lasted many hours, was won by the Cuirassiers, who galloped in at the gorge. At Eckmühl the Austrian Cuirassiers forming the rear-guard of the retreating army were engaged for some time in hand-to-hand combat with the Cuirassiers of the Guard, and the final defeat of the former was attributed partly to the fact that the Austrian cuirasses only protected the breast while those of the French covered the back as well. It is not perhaps generally known that the Life-Guards at Waterloo *without their cuirasses* defeated the French Cuirassiers armed as usual. Light cavalry performs very onerous and important duties. Together with light infantry it furnishes the rear and advanced guards of an army, and when in sufficient number the outposts and videttes; it frequently forages for the army, reconnoitres a tract of country that is to be occupied, disturbs an enemy's communications, intercepts convoys, and follows up a victory; in addition to all this, it is frequently called upon to perform all the duties of heavy cavalry. Some of the best writers seem to be agreed on the following points in the formation of cavalry.

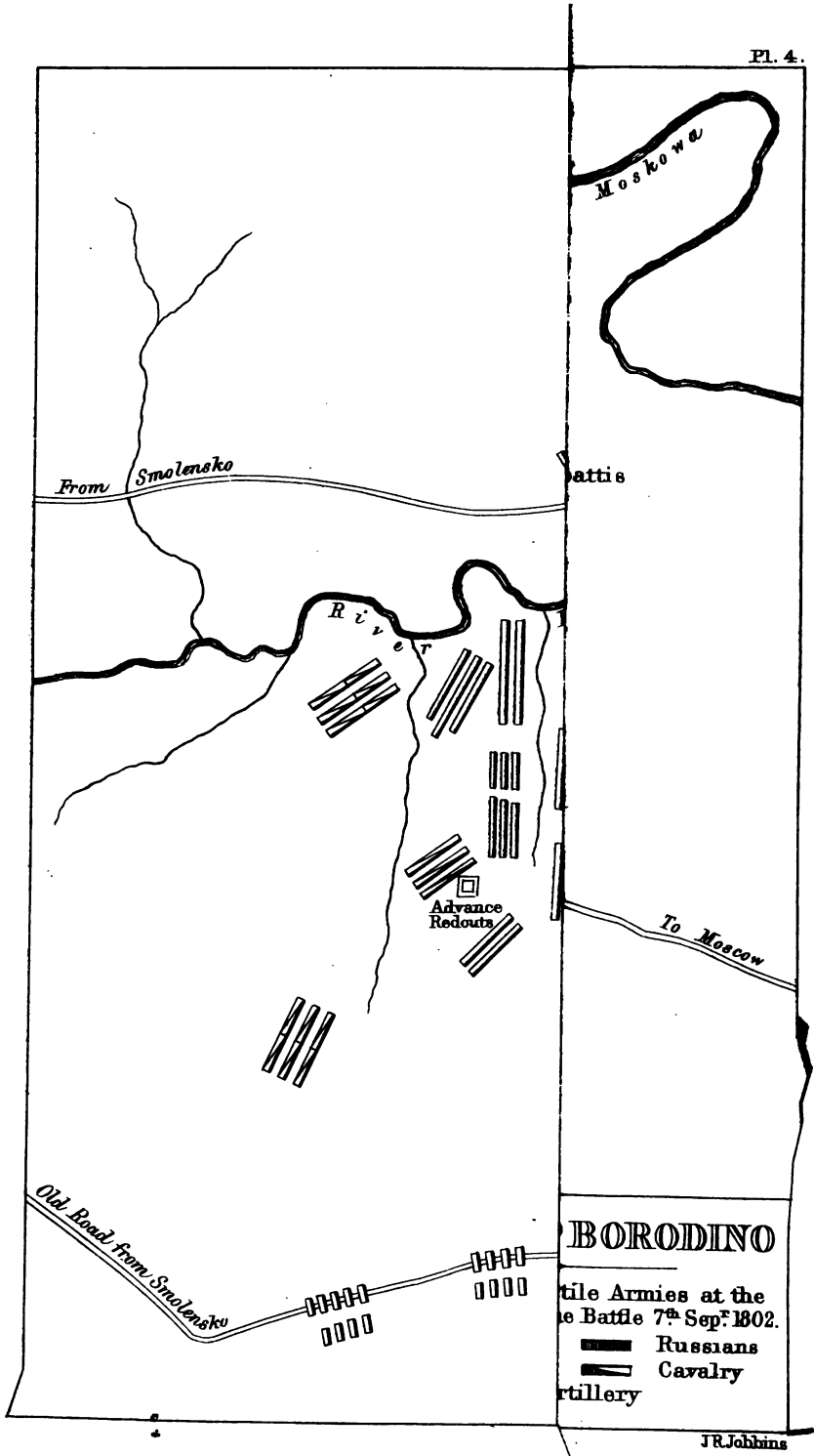
- 1st. That in a charge the line should be formed in single rank; for if it charges in double rank the fire of the infantry will bring down a certain number of the front rank, and their rear rank men will fall over them.
- 2nd. That a line of cavalry should have intervals of at least twelve yards between the squadrons to allow for the opening out of the files at a gallop and to prevent crushing.



3rd. That it is of the very highest importance to keep a reserve in hand ready to hurl on the enemy at a favourable moment, and follow up the success achieved by a charge. In a cavalry engagement, victory has almost invariably fallen to that side which could produce the last reserve. The late Captain Nolan was of opinion that cavalry movements would be greatly simplified by the abolition of rear and flank, and right or left in front ; whether the same holds good of infantry manœuvres is for experienced infantry officers to consider.

ARTILLERY.

No definite rules can be given as to the position which should be occupied by Artillery in a battle; the nature of the ground occupied by the army is the chief point which influences its selection. Points should if possible be selected from which a flanking fire may be directed on the advancing columns of the enemy, such as the salient and re-entering angles of a position. As a general rule artillery does not fire on artillery, except to draw off its fire when directed on the other arms; its object is to shake and thin the masses of an enemy before coming in contact with him. To accomplish this, its fire should be as *concentrated* as possible. The battle of Wagram afforded probably the most striking instance on record of what may be accomplished by the concentrated fire of artillery. (See diagram of battle of Wagram.) Napoleon had fixed the night of the 4th of July, 1809, for crossing the Danube, the island of Lobau being selected for the point of passage. The Archduke Charles had taken up a position to oppose his passage in rear of an intrenchment connecting the villages of Aspern, Essling, and Enzersdorf. On the evening of the 4th July, Napoleon placed his army in the island of Lobau and directed the fire of his batteries on the village of Enzersdorf, silencing the Austrian artillery which was posted there, and setting fire to the village. By the light of the burning village the French Pontonniers threw a bridge across the creek of the Danube separating the island of Lobau from the mainland, and at sunrise on the 5th a great portion had crossed the river and formed on the other side. The Archduke Charles now fell back and took up a fresh position in the plain of the Marchfeldt, between the Danube



not be successful unless supported by artillery; the capture of the guns on the French left may remind us that artillery should not be isolated from its supports; and finally, the importance of intrenched points defended by artillery was well illustrated by the resistance made by the villages of Neusiedel, Wagram, Aderklaa, and Breitenlee.

I now pass on to make a few remarks on the selection and occupation of positions.

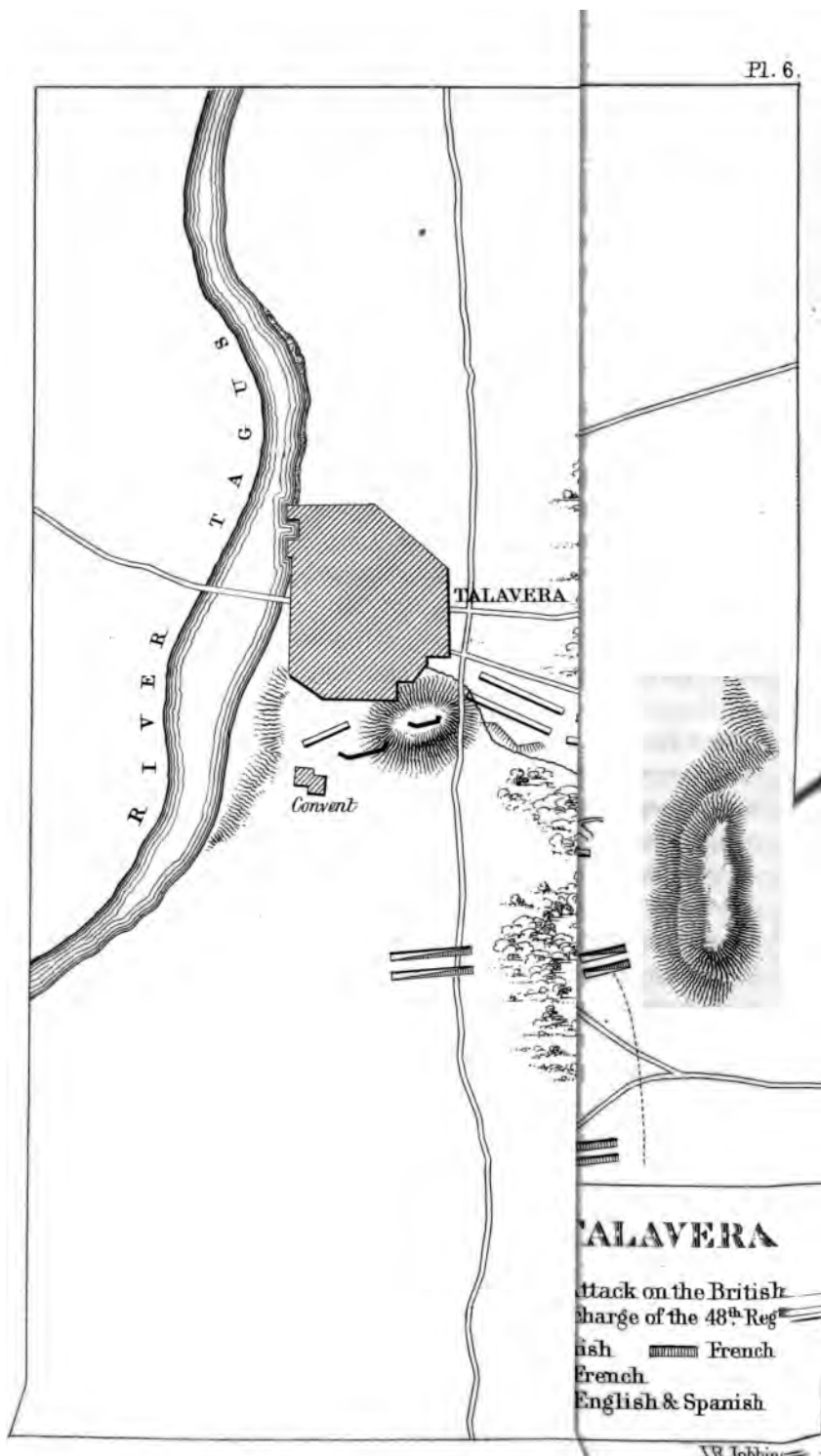
POSITION.

The choice of a Position depends upon the object in view; for a battle should never be fought without a fixed ultimate object. A defensive position may generally be selected by a retreating army in such a manner as to receive the utmost possible advantage, as the general knows that his opponent cannot advance without fighting a battle or he would risk his communications. Such a position is often at a point where several of the main roads converge, or at a point which covers the capital or some other important place. It should be of such a nature, if possible, that both the flanks may be supported by natural obstacles, and the front protected by a stream, marshy ground, &c. which will detain the enemy for a length of time under fire. Where such obstacles do not exist, the position should be strengthened artificially by abattis, redoubts, &c.: unimpeded communications should exist between the different parts of it; and in this respect an order of battle convex towards the enemy is advantageous, because the defenders can reinforce any point by moving on the chord of the arc, while the enemy will have to move on the circumference: finally, the lines of retreat should be as numerous as possible. The Battle of Borodino may serve to illustrate some of the foregoing principles. The Russians had hitherto uniformly followed the system of retiring before the invader, obstinately defending the various decisive points on the line of retreat. They were now, however, approaching their ancient and much-revered capital, and it was felt that to abandon Moscow without a blow would be to exchange the dogged determination with which the Russian troops had hitherto fought for despondency and discontent. Prince Bagrathion, who was selected for the command of the Russian army, in this extremity selected a position for defence on the Moskowa, near the village of Borodino. (See diagram).

His right was supported by woods, earthworks, abattis, &c. on a loop of the stream; as far as the village of Borodino his front was covered by the stream of the Kolotra, whose banks in this part are steep and rugged. Borodino was strengthened and occupied, and from thence to the left the position was artificially strengthened by a large redoubt, open at the gorge and situated on rising ground, defended also by heavy artillery. Three small redans were also thrown up on the left; the woods between them and the great redoubt, and the village of Ulitza, were occupied, and the village itself formed the extreme left of the position. It may also be observed that the Russians had two good roads to retreat by. This position was too strong to be attacked on the right, besides which that position was retired; and on the left the woods would have broken the formation of the attacking masses: the position therefore between the village of Borodino and the small redans was the only one that could be attacked, and thus the great redoubt was the key of the Russian position.

On the 6th September 1812 Napoleon attacked and took a small advanced redoubt near the village of Doronimo, not however without considerable loss; and on the 7th the grand attack on the great redoubt and the redans on the left of it was made, a diversion being also made on the Russian left. For hours the battle raged with unexampled fury round the great redoubt and the redans, which were repeatedly taken and re-taken, the Russians fighting on their own soil, for the safety of their own capital, and with courage wrought up by every possible expedient to a state of frenzy; the French, because life and safety as well as ancient prestige demanded that they should conquer until they could impose terms. At length, after enormous losses on both sides, the redoubt was captured by the Cuirassiers of the Guard, who entered by the gorge: there was but little fighting after this; and the Russians retired in good order, without leaving a single carriage or straggler to mark their retreat.

If an army consists partly of irregular troops, such as militia, &c. which cannot be relied upon to face the enemy in the open field, they should be posted in such parts of a position as are naturally or artificially strong, such as woody or broken ground, intrenched villages, &c. Thus the portion of the position selected by Sir Arthur



Wellesley at the Battle of Talavera, assigned to the Spaniards (see diagram), was rendered so strong as to be almost impregnable by woods, redoubts, abattis, a convent, &c. The line was prolonged by the British, and a hill formed the left of the position, which was about two miles in length; thus the centre was the weakest part of the position. The battle of Talavera was fought because an engagement was inevitable; Sir Arthur had the King and Victor in his front, Soult advancing in his rear, a chain of hills, the passes in which were abandoned, on one flank, and the Tagus on the other; thus all that could be done was to select the best possible position. The most serious defect in the one selected, was that it had but one line of retreat, and that one extremely difficult to be traversed by artillery or carriages. The position too was deficient in one most important requisite, viz. that a position should command all the ground within range of its guns: the hills opposite the British left were as high as those occupied by the British, which caused serious loss from the French artillery. The hill occupied by the British left, enfilading as it did the whole of their position, was the key; and against it and the centre, covered only by a watercourse, the most decided attack of the French was directed. The attack on the right was repulsed and ten guns captured: on the left the British cavalry met with a reverse, but the French did not venture to follow up their success, as there was still cavalry in reserve. In the centre the Guards at first repulsed the French attack, but, pursuing them too hotly, they were in turn attacked and thrown into great confusion; the French pushed on, and the British centre was broken through. The moment was a critical one; but a vigorous charge of the 48th Regiment repulsed the French, who retired at all points to the position they had occupied before the battle. The British were too much exhausted to follow up the victory, and the following day, being joined by Craufurd's Brigade, commenced the passage of the Tagus.

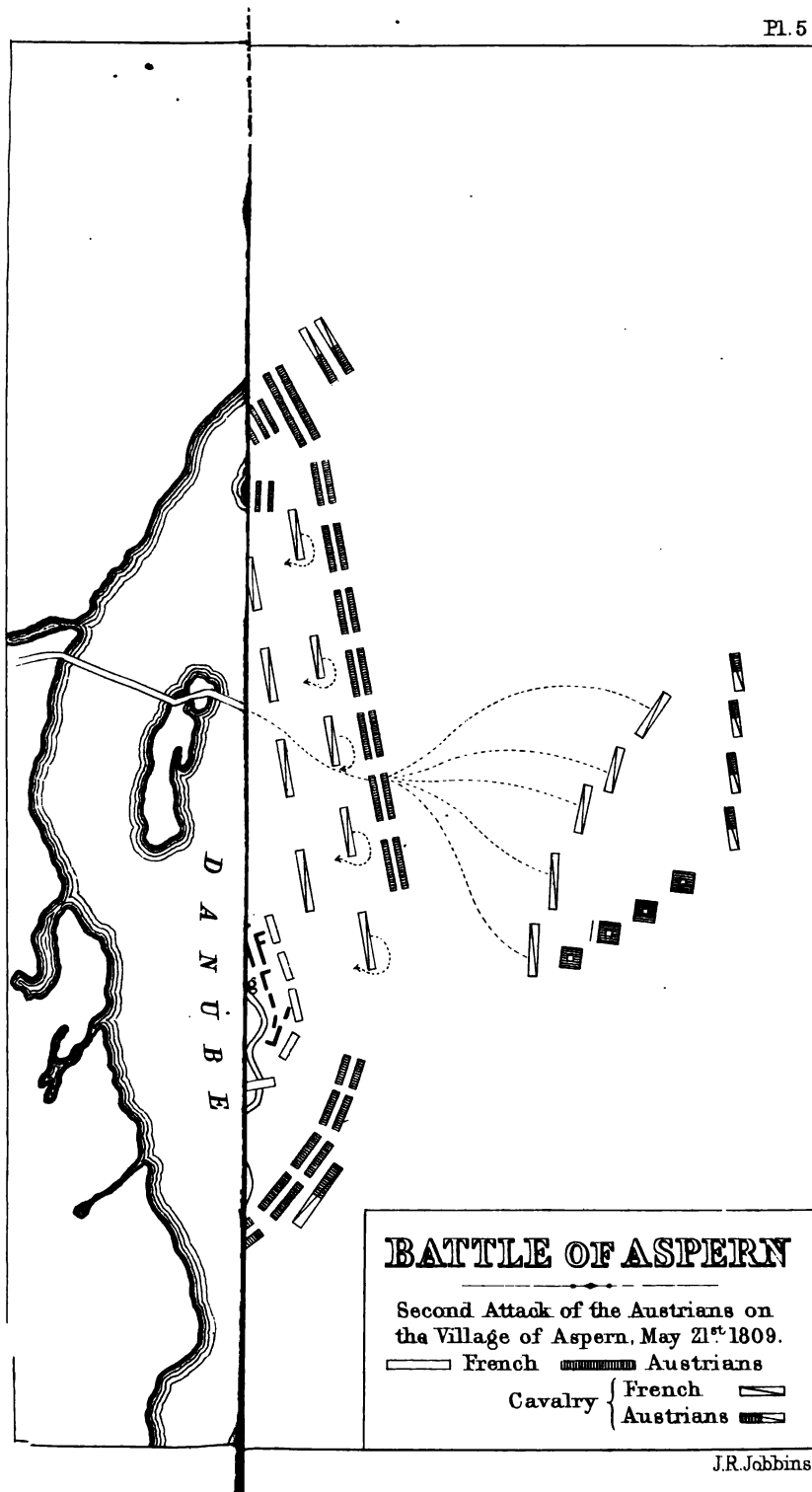
PASSAGE OF RIVERS.

Napoleon said that there were three species of obstacles which an army may have to overcome—a Desert, a Chain of Mountains, and a River; of these the most difficult to overcome is a Desert, the least a River. It may be laid down as a rule that an army provided

with a good pontoon train cannot be prevented from passing a river; and, even when attempted by vive force in presence of an enemy, the passage has often been accomplished. The ways of crossing a river are three, viz. by vive force, by stratagem, or by a combination of the two; of the first, Wellington's well-known passage of the Douro is a brilliant example. Time will only allow to give an instance of the last—the combination of stratagem and vive force.

In the spring of 1809 Napoleon designed to cross the Danube and attack the Archduke Charles, who was still in the field with 100,000 men, although Vienna had been taken: the island of Lobau was again selected as the point of passage. On the evening of the 20th of May, some light troops were pushed across the river in boats, and landed in the island, which was occupied by the Austrian advanced posts; the latter were completely taken by surprise, and had retired to the mainland before the Archduke was informed of the movement of the French. Some of his advisers urged him to oppose the passage; he however adopted a different course, and, ordering the advanced posts to fall back after a slight resistance, he retired with the whole of his army to a distance of eight or nine miles. He saw that Napoleon was making what might well be considered a false movement, and determined to allow a portion of his forces to cross, and then attack them when cut off from the remainder by the river, thus applying our leading principle at his expense. Meanwhile the French constructed several bridges between the right bank and the island, and the passage was commenced. But a single bridge of slighter construction than the others connected the island with the left bank: yet by 12 o'clock on the 21st 40,000 men of all arms had passed over: the villages of Aspern and Essling (see diagram) were occupied, and the space between them held by the Cuirassiers of the Guard under Bessières. Between twelve and one o'clock a column of 30,000 Austrians was seen advancing towards Aspern, and in a short time four others were descried directing their march on the French position.

The battle commenced with an attack on the villages of Aspern and Essling, occupied respectively by Massena and Davoust. Both were defended with desperate tenacity, but the superior numbers of the Austrians made it evident that they must eventually gain ground,





The passage of the remaining troops was, therefore, hurried on, and the Cuirassiers were ordered to charge the Austrian centre. They succeeded in penetrating the first line, but were met by the Hungarian Grenadiers, who threw themselves into squares, and, supported by the cavalry of the centre Austrian column, compelled the Cuirassiers to retire. Meanwhile Aspern was carried and retaken, but again captured: and on the evening of the 21st it remained in the hands of the Austrians, who had closed on the French centre and surrounded Essling. By the morning of the 22nd, the whole of the French had crossed, but the battle was renewed with little better success; Aspern was retaken, but Essling lost; the bridges were destroyed by fire-boats, and some of them with great difficulty reconstructed: a last effort was made on the Austrian centre by the cavalry and Lannes' corps, but without success; finally the French retired with difficulty into the island. The great lesson to be learnt from this battle is, that one of the very worst positions in which a general can place himself is in a confined space with a rapid river running in his rear, and but a single frail bridge to secure his retreat. Why then did so great a master of the art of war place himself in so hazardous a position? The answer must probably be derived from political considerations. "You must accomplish something," said Napoleon, "every three months in order to captivate the French people." The presence of a large Austrian army in the immediate neighbourhood of Vienna cast, as it were, a reflection on his military genius, and it was doubtless his object to beat and disorganise it at all risks.

Evening Meetings.

Monday, June 29th, 1857.

Colonel the Hon. JAMES LINDSAY in the Chair.

The Chairman announced that 25 New Members had joined the Institution since the last Meeting, viz. :—

LIFE MEMBER.

Robinson, R. Spencer, Capt. R.N.

NEW MEMBERS.

Andrews, W. G., Major Royal Artillery.	Strangways, W. A. F., Lieut.-Col. Royal Horse Artillery.
Maxwell, James, Brevet Maj. 84th Regt.	Armstrong, J. W., C.B., Dep. Batt. Colchester.
Henry, G. C., Major Royal Horse Art.	Swann, J. S. Capt., 54th Regt.
Blackett, C. E. Capt. Cold. Gds.	O'Halloran, H. D., Lieut.-Col. Dep. Batt., Limerick
Baillie, A. F., Ensign Bengal Eng.	Lumsden, H. W., Lieut. Madras Art.
Macnamara, F., Lieut.-Col. Clare Mil.	Inglis, T., Capt. Royal Engineers.
Gardner, W. B., Lieut.-Col. Royal Art.	Burrows, A. G., Lieut.-Col. Royal Art.
Malcolm, G. A., Col. unattached.	Baddeley, J. F., Major Royal Artillery.
Dunbar, W. M. Lieut. 34th Regt.	Oldfield, Richard, Capt. Royal Artillery.
Williams, C. P., Lieut. h.p. Land Trs. Corps.	Daniell, C. F. T., Brev. Maj., 38th Regt.
Haggard, W., Capt. East Norfolk Mil.	Stevens, Wm., Capt. h.p. Land Trs. Corps.
Leigh, Lord, Lord Lieut. co. Warwick.	
Strange, H. F., C.B., Lieut.-Col. Royal Horse Artillery.	

INCREASED SUBSCRIPTIONS.

The undermentioned Officer had increased his Subscription from Ten Shillings to One Sovereign since the last Meeting :—

Cartwright, Henry, Colonel Gren. Guards.

DONATIONS.

List of Donations from 16th to 29th June.

To the Library.

Summer Tours in Central Europe, 1855-56. Part 3. Presented by John Barrow, Esq. F.R.S.

Atlas de l'Itineraire descriptif de l'Espagne, par Alexandre de Laborde.

Chart of Holland. Utrecht.

The Royal Navy Men's Advocate, 1757.

Army List, 1764.

Map of the Course of the Scheldt, with the Frontiers of Flanders and Brabant.

List of His Majesty's Royal Navy (Manuscript).

Plans of Dunkirk from the year 646 to the 31st December, 1768 (Manuscript).

Presented by W. F. Higgins, Esq.

Ricordo Pittorico Militare della Spedizione Sarda in Oriente. Presented by General Della Marmora.

Observations made at the Magnetical and Meteorological Observatory at Toronto, Canada, Vol. III. for 1846, 1847, 1848. 4to. London. Presented by H. M. Government.

The only approved Guide through all Stages of a Quarrel. 12mo. Presented by Major-Gen. Falls.

Miscellaneous.

1. Fruit of the Coco de Mer of the Seychelles Islands, Indian Ocean.

2. Salmon caught with rod and line in the river Ness in Feb. 1857 by General Sutherland. Presented by General Sutherland, C.B.

Portrait of the late Duke of Wellington, with Autograph. Presented by John Barrow, Esq. F.R.S.

ON THE REGIMENTAL SCHOOLS OF THE FRENCH ARMY.

BY MONTAGUE GORE, Esq.

THE regimental schools of the French army are divided into two classes—one class for the privates, the other for the non-commissioned officers. I will first give a short account of the former.

Monsieur Roland, the inventor of the system pursued in these schools, and at present their general superintendent, was the master of a small village school, near the country residence of the late Marshal Soult, then Minister of War; who, having become acquainted with Monsieur Roland's method of instruction, was so much pleased with it, that he appointed a commission to inquire into its merits. It was arranged that fifty lessons of two hours

each should be given to four hundred pupils according to Monsieur Roland's method, and the same number of lessons to four hundred others according to that which was then followed in the French army. The report of this commission, which was made in 1840, was so favourable to Monsieur Roland's method, that it was adopted, and has since been pursued in every regiment.

Every regimental school is under the direction of an officer of the rank of lieutenant or sous-lieutenant, who has under him a monitor-general of the rank of serjeant, and three monitors. The director, monitor-general, and monitors, are exempted from all regimental duty. The director receives no allowance for his attendance at the school; the pay of the monitor-general and three monitors for a quarter amounts on the average to £1 16s.* of English money. For every school of 200 pupils there are required 200 tablettes, 200 syllabaires (or school-books), 200 copies of the Gospel of St. John, a collection of copy-books, 3 large slates, 300 slate-pencils, 288 pencil-cases, and a few other articles; the cost of all which for a school of the size mentioned in Paris is about £27 English money. The other, or, if I may so call them, the *working* expenses of a school of 200 pupils once thus established, amount to £2 a quarter, or a little more; if to this be added £1 16s. for the pay of the monitors, the total expense of a school, after that incurred for its first establishment, does not amount to more than about £4 per quarter.

Each school, when two or three battalions of infantry are quartered together, consists of 200 pupils; where there is only one battalion, of 100; and the same with respect to cavalry. The attendance is compulsory on all soldiers who are unacquainted with reading, writing, or arithmetic. When this number exceeds 200, the major of the regiment selects those who are first to be sent to the school. No tables or seats are required, each pupil being provided with a tablette, which is suspended in front of the breast by a cord passing over the shoulders; a slate is inserted in it, and it answers the purpose of a table for writing; and also, being

* This sum may appear very small, but it must be remembered that the monitors continue to receive their regimental pay. I state the amount on the authority of Monsieur Roland, the superintendent of the schools.

hollow, of a locker to keep pens, school-books, and paper. The men are required to stand up during their lessons, which last for two hours each.

The officer who is the director must himself be fully acquainted with the system; he instructs the monitors, who afterwards teach the school.

It would be impossible within the limits of this lecture fully to detail the mode of instruction pursued; but the following brief account may give some idea of it:—

All the pupils being drawn up in line, a monitor proceeds to instruct them by means of a large slate suspended in front of him, on which all the letters of the alphabet are written. He points with a stick to each letter in rotation, pronouncing it, as he does so, with a loud voice, the pupils repeating after him; the monitor marking with his stick the regular time of the “*pas ordinaire*,” in order that the pupils may pronounce with one uniform cadence. After having done this several times, he calls on some one pupil, to whom he gives his stick (or “*baguette*”), desiring him to point with it to each letter, pronouncing it aloud as he does so. The monitor then names particular letters of the alphabet, and requires the pupil to point to those he names. The pupil then returns to his place in the ranks, and others are called out, who are successively exercised in the same way.

Instructions are next given in spelling, pronouncing syllables, and reading.

The book in which they are generally first taught to read is the Gospel of St. John. The monitor announces that he is about to read some particular chapter, and that the pupils will be expected to follow him, and to pronounce the words after him. He then proceeds to read, observing, as in reading the alphabet, the regular cadence of the “*pas ordinaire*,” in order that all the class may repeat simultaneously after him. It is material to observe that after reading the alphabet, spelling, or reading any book together, the pupils are called on to do so individually, in order the better to test their proficiency. Every pupil, besides being provided with a “*tablette*,” has a “*syllabaire*,” a copy of the Gospel of St. John, pencils, slate-pencils, pens, ink, and paper, which he is allowed to

take into his room, in order that he may follow up there the instructions which he has received.

In learning to write, the pupils begin by copying on the slates of their "tablettes" the letters, syllables, and words contained in their syllabaires. Copy-books are then given them with transparent paper over the copies, which they trace, thus learning the true slope and formation of the letters, and acquiring steady hands. After being perfect in this practice, they are no longer allowed the aid of copies to imitate, but are made to learn by heart a passage from some book; for instance, from the syllabaire (or school-book), or the *Théorie Militaire*, and then to write it from memory, afterwards comparing what they have written with the passage in the book, and correcting any faults of orthography.

In giving instructions in grammar, the monitor teaches the school how to form the plural of substantives in the following manner. He writes on the slate, suspended as I have mentioned before him, a certain number of substantives, which the pupils first spell and read, after which he explains to them how to form the plurals. They are then ordered to write on the slates of their tablettes the words which they have just spelt and read in the singular, after which they write the same words in the plural also, according to the instructions that have been given them. They are then taught how to connect adjectives with substantives, and pass on to the verbs.

The monitor explains to them the terminations of the present infinitives of the different conjugations, and the different moods and tenses of verbs. He then states what is the meaning of the verb, its subject, and its object.

The syllabaires of which I have spoken contain the principles of grammar and the rules of arithmetic; and the pupils are expected to learn out of school-hours in their rooms the verbs of the four conjugations given in the syllabaire, as well as the auxiliary verbs avoir and être. When they have learnt these, the monitor writes on the slate in front of him the infinite of some verb not contained in the syllabaire, say *commander*. The pupils compare this verb with the infinitives of the different conjugations in the syllabaire, and, finding that it corresponds with that of *aimer*, or the first conjugation, they conjugate it accordingly. After a few lessons, they

no longer require to refer to their syllabaires, but conjugate without assistance any verbs of which the monitor gives them the infinitive.

The syllabaire contains the definition and use of the parts of speech. After the pupils have studied these, they are examined in the following manner:—The monitor writes a sentence, say, “Le soldat prend son fusil.” The pupils are required to mention the nature, gender, and number of each word as the monitor points to it. Thus, when he points to “Le,” the pupils say, “Le, article, masculin, singulier.” The monitor asks, “What is an article?” and the pupils answer according to the definition which they have learnt in the syllabaires. He then points to the word “soldat,” and the pupils say, “Soldat, substantif commun, masculin, singulier.” He then asks, “What is a substantive?” and they reply again according to the definition given in the syllabaires. They are then examined in the same way as to the remaining words.

In teaching arithmetic, the monitor commences by writing three rows of figures as beneath:—

No. 1.	No. 2.	No. 3.
1	10	100
2	20	200
3	30	300
4	40	400
5	50	500
6	60	600
7	70	700
8	80	800
9	90	900
0		

He then remarks that the zero has no value by itself, but is of importance when joined to figures; that 4, for example, which in the first column represents only 4 units, indicates 40 in the second, because one zero is attached to it; and 400 in the third column, because two zeros follow it. He then points out to them how by decimal progression numbers amount to a hundred, then to a thousand, and then to a million.

The pupils are next instructed in the rules of arithmetic, and in the meaning of weights and measures.

CLASS OF CORPORALS.

Those admitted into this class are required to have previously gone through the course of instruction above mentioned in the schools, unless they have acquired the same amount of information without doing so. The pupils of this class read aloud, and afterwards learn by heart, a small book called "*La Théorie Militaire*," in which are explained all the exercises, manœuvres, and duties of infantry. They also, as indeed do all officers and non-commissioned officers, go through a course of instruction in intonation; the object of which is to enable them to give the words of command simultaneously in a loud and distinct voice. On one occasion I saw the non-commissioned officers going through this course at the barrack of the *Ecole Militaire*. The colonel in command told me, that, when first this practice was proposed, it was treated* with considerable ridicule; but that its utility is now admitted, and that it is pursued in all the French army. He mentioned, too, that the voices of many men previously weak became strengthened by the exercise.

As I have already stated, I do not presume within the limits of a lecture to give more than a faint and imperfect outline of the system pursued in these schools. I may mention that I have visited them on more than one occasion. Every facility is given to those who are desirous of observing the working of the system, and Monsieur Roland is always anxious and happy to give the fullest information. His method of teaching has been in use in all the regimental schools since 1840; and he states that experience proves that a soldier, previously quite uninstructed, can acquire in these schools, without in any way neglecting his regular military duty, the instruction necessary to enable him to pass the examination required for attaining the rank of a non-commissioned officer, in the course of ten or twelve months;* that is to say, that he can become perfect in that time in reading, writing, and the four rules of arithmetic.

* The attendance required from each pupil in the school is twice a week for two hours each time. The school is open, and the director and monitors are obliged to attend five days in the week, the soldiers attending on the days they are off duty; but no soldier is required to attend more than twice a week.

I will now say a few words on the schools of the second degree, or higher class—those intended for the non-commissioned officers. No private soldier can be promoted to the rank of non-commissioned officer without passing an examination to prove that he is acquainted with reading, writing, and arithmetic; and no non-commissioned officer can be promoted to the rank of officer without undergoing a further examination, except in special cases where promotion is conferred for acts of valour in presence of the enemy. The commanding officers of regiments make a return every year to generals of division, and these to the minister of war, of the names of those non-commissioned officers whom they think eligible by their good conduct and their attainments to be promoted to the rank of officer. By an order of Marshal St. Arnaud, when Minister of War in 1853, it was enacted that no non-commissioned officers should be promoted, unless they had gone through the following course of study for two years, and could pass examinations in the subjects mentioned:—

First year: French grammar, arithmetic, geometry, military administration. Second year: Geography, history, fortification, study of maps. They are required to attend two lessons a week, each lesson occupying two hours. The second lesson of each week is devoted to the repetition and examination in what has been taught in the first.

The official programme states that the course of arithmetic includes the knowledge of common and decimal fractions; that of geometry the knowledge of angles, triangles, polygons, mensuration of surfaces, and of solids; that of military administration a full acquaintance with everything connected with the pay, commissariat, clothing, and lodging of the soldier; with hospitals and prisons; with the interior administration of companies and squadrons. The object of the course of geography is to give them general ideas of the science, and it is observed in the programme that good maps are of more use than fatiguing, and perhaps disgusting, the pupils, by loading their memories with proper names. The course of history comprehends not only the history of France, but general modern and ancient history. The commission appointed by the French government to make a report on these studies say that they

consider this course one of the most useful, and especially recommend it. They are, however, of opinion, that a general acquaintance with ancient history is sufficient, but that a more detailed knowledge should be required of modern history, especially of the military operations during the consulate and empire. The course of fortification is preceded by a lesson in descriptive geometry, and its object is to make the pupils acquainted with field fortification, the attack and defence of military posts and fortresses, the nature of the works required to protect them, and the communications between the several works.

In concluding this brief account of the system of instruction pursued in the French Regimental Schools, I have only further to observe, that it is not my intention to make any comparison between it and that which is followed in those of our own army. France and England were long opposed to each other in hostile array; more recently they have fought side by side as rivals for glory in one and the same honourable cause. May their armies henceforth emulate each other in good conduct, intelligence, and discipline! The education of the English soldier has been greatly improved of late years; the regimental schools of our army are conducted on an excellent system, and are well attended; and the men have every encouragement to pursue their studies under the auspices of that illustrious prince who commands the army, and, amongst whose other titles to the gratitude of the country, none is more honourable than that which he has so justly earned of "The Soldier's Friend."

After Mr. Gore had concluded the reading of the above paper, the following discussion took place :—

The Rev. G. R. GLEIG, Chaplain-General to the Forces, said he had the advantage of going through all the French schools, from the primary schools in the regiments up to the very highest schools in which the officers were taught. With regard to the regimental schools, he thought they were about the most defective, and the most miserable pretences, that ever could be witnessed. He never in his life saw an attempt to educate by signs and signals which so completely failed. In the British army they had a system

of education ten-thousand-fold superior to that which existed in the French army.

Colonel DE HORSEY asked the Lecturer whether the professors at the French schools were paid by the government.

Mr. GORE said they were, but the pay was very small.

The Rev. Mr. BIRCH, an Independent minister, formerly an officer in the army, said that the system of education adverted to by Mr. Gore was introduced into Paris more or less in connection with himself. He was in the exercise of his ministry there in the years 1838 and 1839, and he received a letter from the country recommending to him a poor French village schoolmaster. He was desirous of getting recommended to Marshal Soult, in order to introduce to him his system, which he had devised in the midst of his rural labours. That introduction was obtained, and the poor man was allowed to make an experiment with his system. On further trial the old system was entirely put aside, and the poor village schoolmaster's system was adopted.

Captain BAILEY said, he had had some little connection with the French troops from having been posted near them, or actually with them, before Sebastopol, for upwards of six or eight months. He had always been under the impression that they had a very high system of military education, but, upon inquiry into the state of things, he was quite surprised to find that their system of education was not equal in any respect to that which exists amongst the regiments in her Majesty's service. Not one-tenth of the men in a French regiment were able to write the commonest sentence in French; and not only was that the case, but it also extended in a great measure to the officers themselves. He believed it would be found that the education in the French army extended only to certain classes of officers, namely, those who had been at the schools of St. Cyr and the Polytechnique, and those officers were rendered available for staff purposes.

Mr. GORE thought that the public papers made a very great mistake a short time ago, when they commented upon the superiority of the foreign schools to the English, because foreign languages were taught in them. That might be the case in Germany, but it was not so in France. Only the other day he went over a school in

France, and he asked the colonel whether English was taught. He replied that no foreign language was taught but German. Last year there were 700 pupils at St. Cyr, and not one of them could speak a word of English.

The CHAIRMAN (Colonel Lindsay) said, that our own military schools were working to as good an end as schools could possibly work. Before the war there was no doubt whatever that the system was not so perfect as it was at the present moment. He was greatly in favour of teaching a soldier a useful trade, so that when he went back to his parish, after having served under the Limited Enlistment Act, he might not only be a better man, but a useful member of society—able to support himself. It was both a moral and a physical question, and also a question of good government, and they ought to be greatly obliged to Mr. Gore for raising it.

Wednesday, July 15th, 1857.

Rear-Admiral Sir T. HERBERT, K.C.B. in the Chair.

The Chairman announced that 11 New Members had joined the Institution from 30th June to 15th July viz.—:

LIFE MEMBERS.

Bell, Chas. Wm., Lieut. 15th King's Hussars.	Smith, Horace J., Cornet South Herts Yeomanry.
Farmer, W. R. G., Lieut. Gren. Gds.	

NEW MEMBERS.

Blackett, E. W., Captain Rifle Brig.	Inglis, Chas. D., Lieut. R.N.
Nason, John, Major Dep. Bat. Athlone.	Daubeney, A. G., Captain h.p. 90th Ft.
Boyle, C. E. W., retired Rear-Admiral.	Hartley, Rd. W., Captain 94th Foot.
Pennington, Hon. J. F., Capt. h.p. 90th Foot.	McDonald, A. M., Major Rifle Depôt Battalion.

INCREASED SUBSCRIPTIONS.

The undermentioned Officer had increased his Subscription from Ten Shillings to One Sovereign since the last Meeting:—

Pennington, Hon. Jno. Fras., Captain h. p. 90th Foot.

DONATIONS.

List of Donations from 30th June to 15th July.

To the Library.

Two manuscript copies of Lectures, delivered by General Sarey at the Senior Department of the late Military College at Wycombe. Presented by Charles E. Long, Esq.

Three copies of the Report of the Dublin Sailors' Home. Presented by General Falls.

Archæologia, Vol. XXXVI. Parts 2 and 3, and 3rd Part of Vol. I, Proceedings, &c. 43 to 46.

List of Fellows for 1856 and 1857.

Presented by the Society of Antiquaries.

The Royal Warrant of the 6th October, 1854, and its effects on the Lieut.-Colonels of the Army who had obtained that rank before the 20th June, 1854. Pam. 8vo. London, 1857. Presented by Col. the Hon. J. Lindsay, Gren. Gds.

Annals of the Wars, 1700—1739, 1 vol. 12mo. London, 1857. Presented by Major-Gen. Hon. Sir Edward Cust, K.C.B.

Alphabetical List of the Officers of the Gren. Gds. from 1800 to 1854.

Ditto ditto 79th Highlanders, 1800 to 1851.

Ditto ditto 4th R. I. Drags. 1800 to 1856.

Military Obituary for 1853—54—55—56,

Presented by Henry Stooks Smith, Esq.

Report on the Examination of Appointments to the Royal Artillery, and Admissions to the Royal Military Academy at Woolwich. Presented by Col. Lefroy.

Proceedings of the Royal Society, Vol. VIII. No 26. Presented by the Society.

The Isthmus of Suez Question, by M. Ferdinand de Lesseps.

Ma Mission à Rome, Mai 1849. Par M. F. de Lesseps.

Six Numbers of the Journal de l'Union des deux Mers, 20 to 26.

Réponse de M. F. de Lesseps, au Ministre et au Conseil d'Etat.

New Facts and Figures relative to the Isthmus of Suez Canal. Edited by M. de Lesseps.

Inquiry into the Opinions of the Working Classes of Great Britain on the Suez Ship Canal. By M. F. de Lesseps.

Isthmus of Suez Ship Canal Report, and Plan of the International and Scientific Commission, with Appendix.

The Gates of the East. By Charles Lamb Kennedy, Esq. Barrister-at-Law.

Atlas. M. F. De Lesseps sur Percement de l'Isthme de Suez. Presented by Major-Gen. Honble. Sir Edward Cust, K.C.B.

Miscellaneous.

Mass of Spar found near Frome, in Somersetshire, in the year 1840. Presented by Mr. S. Naylor.

A Carabine à tige. Presented by Lieut.-Col. T. St. Leger Alcock.

REAR-ADMIRAL SIR T. HERBERT, K.C.B., in the Chair.

EUCLID RENDERED PRACTICALLY AVAILABLE TO THE
EXIGENCIES OF MILITARY SERVICE, IN THE USES
OF THE INSTRUMENT CALLED THE POLYMER.

BY THE REV. F. R. A. GLOVER, M.A., CAMB., THE INVENTOR.

"EUCLID" being rather a dry subject, the object of the Lecturer in adopting the above heading for the Lecture was the endeavour to make that Great Master a favourite in quarters where his matter is looked upon rather as a dose of physic than as an agreeable condiment. This was done by showing the practical utility of his labours in their application to all those points of military resource realizable by the instrument, the POLYMER, to which he drew the attention of the audience; his statement being, that, inasmuch as all Geometrical Instruments were based, in their action, on certain principles in physics, exhibited in some of the books of Euclid, and as this Instrument combined the uses and operations of many, this one might be considered a working model by which to exhibit practically, and to realise in a handicraft way, the results of all the books of that ancient author.

Having stated this intention, the Lecturer then proceeded to show the order of the growth of the Polymer out of the common Sector, which it resembles in form, though it has no working resemblance to that instrument, all its lines of graduation being entirely different, the sectoral lines of the common sector being all obtainable in the Polymer otherwise. Yet, as, besides doing all the trigonometrical work of the sector, together with that which is usually performed by the sextant, protractor, magnetic surveying-compass, spirit-level, Marquois' scales, proportional compasses, and calliper compasses, it adds to the powers of all these instruments those of a reflecting azimuth, a mid-day dial, and ready-reckoner, its title to its name is well established. For it is in this combination of many instruments in one, of which the common sector is the basis, that all the processes of mensuration can be achieved, without recourse to any other instrument or means other than

those which the Polymer itself provides: the elements, for example, for heights and distances being obtained by the Polymer, the practical result is realised on the spot, without recourse to square root or logarithms; the ground problems can be also worked on the ground or ramparts and breastworks thrown up, without the aid of stakes, pickets, or lines.

The accompanying Plates will give our readers a better idea of this OFFICER'S VADE MECUM than any lengthened report of the Lecture, or description of the instrument as given at the time, in illustration of its range: to do so would, indeed, be to reprint a book of some bulk, explaining its various uses and powers, published elsewhere.

The following detailed description of its appearance, and catalogue of its uses and contents, may not be unacceptable to our readers. It is a metallic folding foot-rule, 7 inches long, $2\frac{1}{4}$ inches wide, $\frac{3}{8}$ of an inch thick. It is so arranged that it shall be a standard of weight, viz., a test of a pound imperial, as well as a standard of lengths and liquids. The leathern case of the instrument constitutes the sketcher's tablets and memoranda book.

STRUCTURE AND CONTENTS OF THE POLYMER.

No. 1, Protractor.—A six-inch Sector with 1-inch radius joint, and graduated disc, showing the 360 degrees of the circle, with a Vernier's scale to read to 1 minute of a degree, constituting a Protractor.

No. 2, Quintant.—No. 1, with a hinged mirror in the middle of the disc of the joint, constituting a quintant, reading to 160° , that is, taking angles up to 160° .

No. 3, Double Sextant.*—No. 2, with a hinged mirror *en annexe*, constituting an instrument which takes an angle of 260° ; being more than 120° (the sextant's range) multiplied by 2; and no "bad" angles.

No. 4, Reflecting Quintant Compass.—No. 2, with a magnetic needle in a revolving needle-box, with Sight Vane, reading from 15° to 160° E. and W. of meridian. The magnet is no longer needful for road, lane, and boundary surveying, it being superseded for such purposes by No. 3.

No. 5, Artificial Horizon, $\left\{ \begin{array}{l} 1, \text{ With a spirit-level.} \\ 2, \text{ A pendulum with horizontal balance.} \\ 3, \text{ Metallic mirror, variously used.} \end{array} \right.$

No. 6, Gunner's Quadrant.

No. 7, Meridian Dial, Latitude Instrument, and Azimuth Circle.—Nos. 4 and 5, with mirror, double-faced and lined on each face.

No. 8, Telescope en annexe, (extra.)

* This has been added to the Polymer since the delivery of the lecture.

- No. 9, Ball-and-socket Walking-stick Tripod, (extra.)*
No. 10, Proportional Compasses.—Three comparative graduations for circles, planes, and solids.
No. 11, Calibre Compasses.—Calliper scales on the reverse of the disc, for diameters of balls and their weight. Sliding rule from $1\frac{1}{4}$ to 18 inches for internal calibre.
No. 12, Universal Scales and Triangle, Parallel Ruler.—23 linear English graduations from 2 to 24 to the inch, including those of Marquois' scales. Three foreign. Foreign mile ladder.
No. 13, Trigonometer.—Line of lines with graduated square, being a Sining-Rod for sines, with a Vernier's scale. Graduated three-quarter circle, with Vernier of No. 1 for angles.
No. 14, Slope-gauge, a substitute for pickets and tapes in throwing up parapets, &c., the combination of No. 13 with 1 of No. 5.
No. 15, Stadium for taking distances at sight.
No. 16, Standard of weight.
No. 17, Thermometer, (extra.)
No. 18, Case and Sketching-tablets.

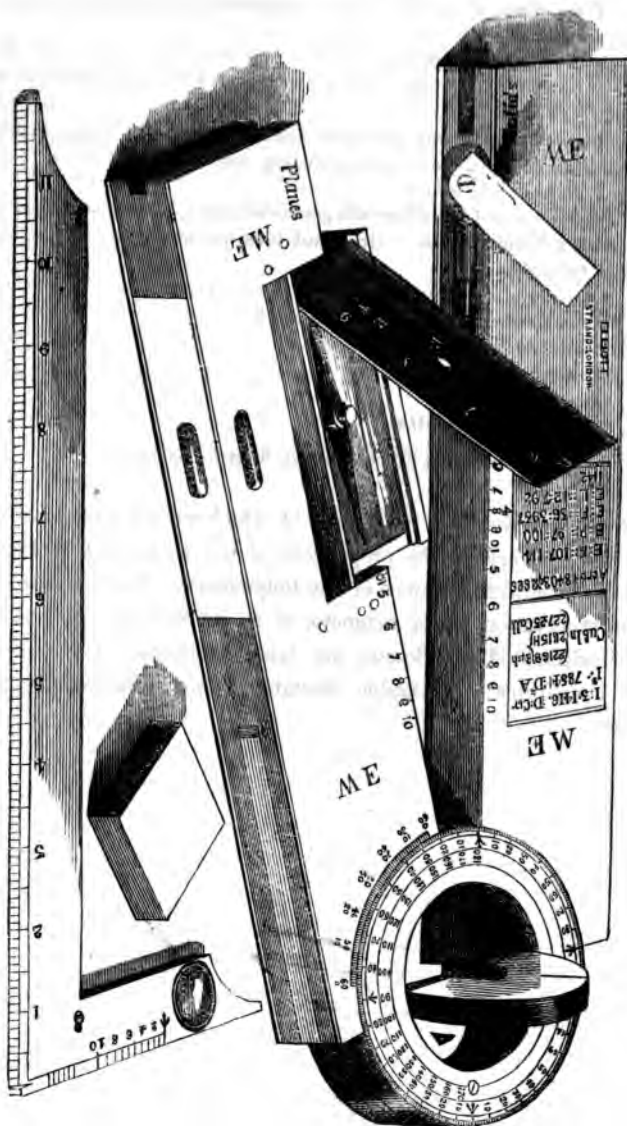
To be had at Elliott Brothers, Strand, London.

The annexed woodcut, for the use of which we have to acknowledge the courtesy of the proprietors of the Illustrated Inventor, shows the general appearance of the Polymer, as it is arranged to take an observation either magnetic or as by Sextant. The Artificial Horizon and the Square are lying beside it. The *annexe*, which constitutes the Double Sextant, is not exhibited in the woodcut.

ERRATA.

Page 42, line 4, for "lochi," read "syntagma."

" last line, for "Macedonians," read "Spartans."



The POLYMER. The OBSERVING FACE

PLATE

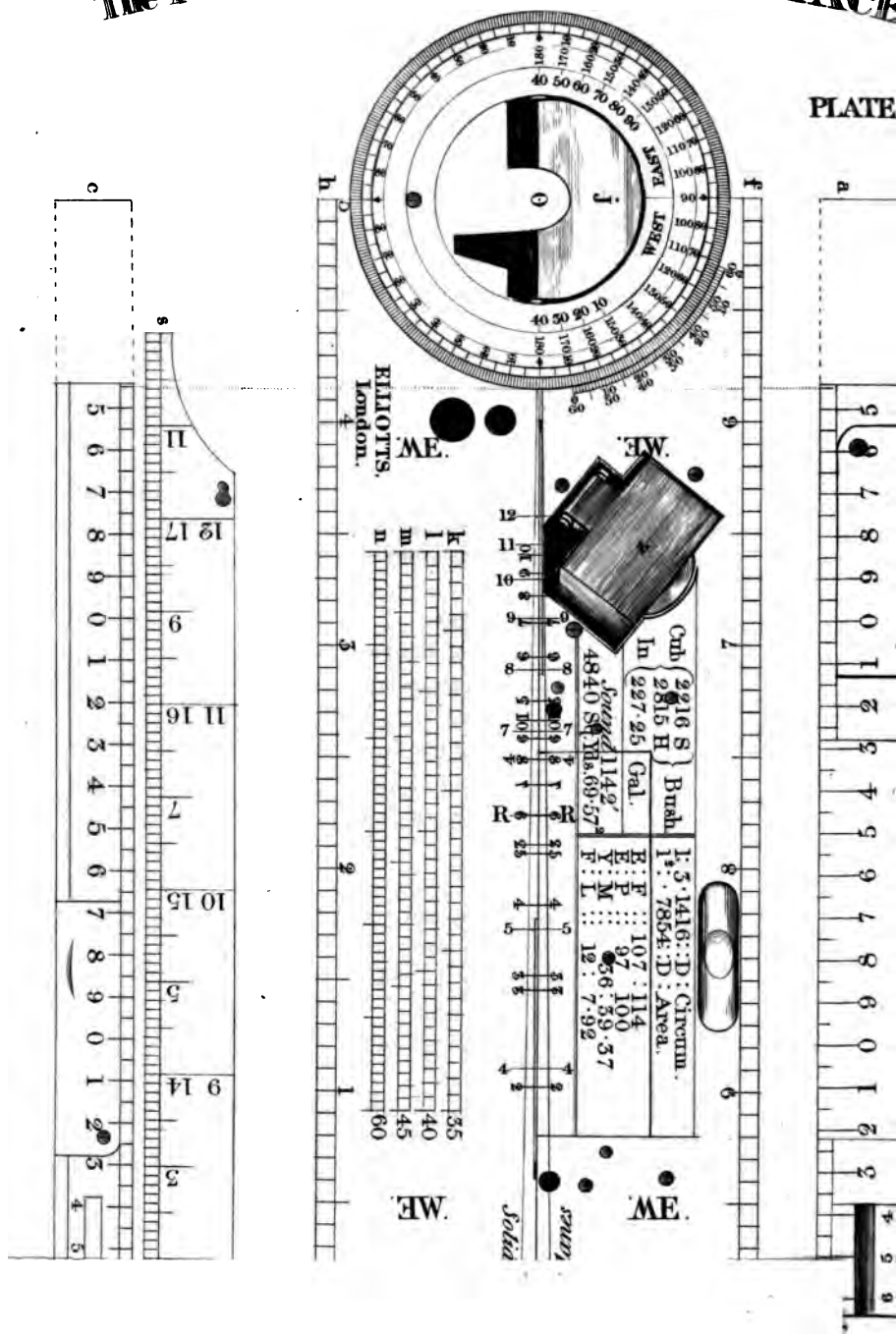


PLATE II.

THE POLYMER. THE OBSERVING FACE.

a b, c d.—Inner edges of the Sector, showing a scale of 4 inches to a mile in yards. Each portion represents 50 yards, and each number stands for as many hundred yards from the centre of the joint of the instrument at *o*.

e.—The air-bubble of the spirit-level.

f g h i.—The foot English in tenths and hundredths ; the scale of 50 of Marquois.

j.—The folding-down reflecting mirror.

k, l, m, n —Scale of 35, 40, 45, 60 of Marquois' scales.

o.—The centre of the joint of the instrument.

q p s.—The square, graduated to the scale of 60 of Marquois, and marked with the numbers of the draw-rule in inches. The other numbers stand for half-inches. The circle at its end represents a small lens, with which to read off the circular Vernier scale.

o r, o u.—Radial lines, showing the proportions of the proportional compasses in planes, solids, and polygons. The numbers read in accordance with the words to which they belong.

u u, r r.—The same, prolonged over the ends of the Sector.

o t.—The middle joint of the instrument.

t t.—The opening of the point at the end of the legs of the Sector.

v w, y x.—The end of the instrument.

z.—A falling mirror—the mirror, *en annexe*, alluded to under head No. 3, *Double Sextant*, in page 281.

PLATE III.

THE POLYMER. THE SCALE'S FACE.

a b.—The Stadium scale for man and horse, on one of the outer edges of the Polymer.

c d.—Scales of 7, (14.21,) 9, (3.6, 12.15,) 11, 13, 17, and 19 to the inch.

c d, s v, when the Sector is opened out, constitute the foot measure, to the inches of which, the numbers 1 to 12 inclusive refer.

s r is a scale of 6 inches, the $\frac{1}{2}$ foot; the inches are divided in 8ths.

e is the air-bubble of the spirit-level.

e f.—The Calibre scale for the measure of balls, &c.

f g.—The Calibre scale of weights of balls.

h i.— $\frac{1}{2}$ of the French metre, shewing decimetres and millimetres.

j k.—Diagonal scale of hundredths to the half and quarter inch, each subdivided into hundredths.

l m.—A scale of 3 inches to a mile on the other outer edge of the Sector.

s p q.—The square graduated to 20ths of an inch; the numbers shew half-inches.

n.—Tell-tale lines.

o.—The Vernier, for the line of lines.

o t.—The middle line of the Sector; the two edges shew a graduation of 20 to the inch, and are the same as the line of lines of the Sector.

o r, o u.—Radial lines for using compasses.

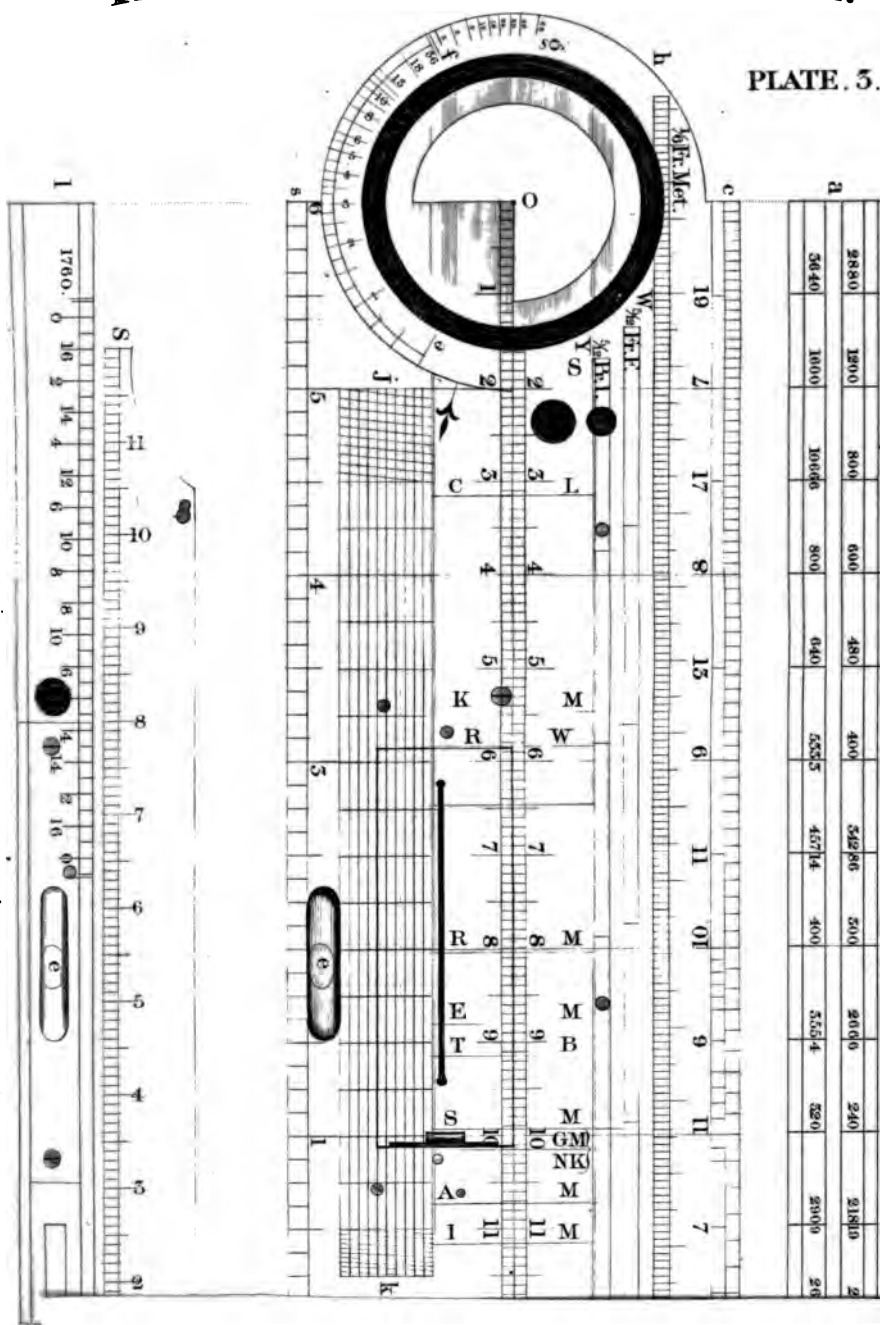
v x y w.—The ends of the Sector.

w x.— $\frac{1}{12}$ of a French foot.

y z.— $\frac{1}{12}$ of a German foot.

The POLYMER, The SCALE'S FACE.

PLATE 3.



THE
Journal
OF THE
United Service Institution.

VOL. I.

1858.

No. IV.

PROCEEDINGS AT THE TWENTY-SEVENTH
ANNIVERSARY MEETING.

AT a General Meeting of the Members of the UNITED SERVICE INSTITUTION held in the Lecture Theatre of the Institution, Whitehall Yard, at Two o'clock, P.M. on Saturday, the 6th of March, being the Twenty-Seventh Anniversary Meeting,

The Right Honourable SIDNEY HERBERT, M.P., Vice-Patron of the Institution, in the Chair,

I. The Proceedings of the last Anniversary Meeting were read.

II. The Minutes of the Special General Meeting of the 4th of January, 1858, were read.

III. The Annual Report of the COUNCIL was read, as follows :—

1. In submitting to the Meeting the Twenty-seventh Annual Report, the COUNCIL have much satisfaction in stating that the past year has been one in which much has occurred to elevate the character and confirm the stability of the United Service Institution. Although their sanguine expectations may not have been altogether realised, either in the amount of support received from the naval and military services, or in the full development of the professional objects to which the Institution is devoted, yet the COUNCIL have reason to congratulate the Members upon the increasing interest with which the Institution is regarded, and the assistance which they have derived from Her Majesty's Government.

2. The embarkation for India of a large portion of the army stationed in this country has been disadvantageous to the interests of the Institution. The COUNCIL had obtained the co-operation of many officers of high rank in the various military districts, and local committees were on the point of being organised, for the purpose of making its objects more generally

GENERAL ABSTRACT OF THE ACCOUNTS OF THE UNITED SERVICE INSTITUTION

FOR THE YEAR 1857.

ORDINARY EXPENDITURE.					£	s.	d.			
Secretary's Salary	.	162	9	8	Annual Subscriptions at 10s. for 1857	.	.	.		
Clerk's do.	.	72	0	0	Do. do. above	.	1,101	6	0	
Donation to Clerk	.	20	0	0	Do. do. arrears	.	39	10	0	
Servants' Wages	.	299	18	10	Do. do. advance	.	5	10	0	
Do. do. Clothing	.	36	3	0	Total Annual Subscriptions	.	.	.	.	
Fuel	.	41	19	6	Entrance Fees	.	.	1,258	4	0
Lighting	.	16	14	6½	Donations	.	.	179	0	0
Household Sundries	.	20	9	7½	Grant from Government	.	.	53	12	0
Postage	.	24	15	2	Dividends	.	.	400	0	0
Assessed Taxes	.	99	1	6		.	.	.	.	.
Income Tax for Secretary, Clerk, and Porter	.	27	5	0		.	.	.	.	.
Parish Rates	.	111	3	4		.	.	.	.	.
Water Rate	.	10	0	0		.	.	.	.	.
Ground Rent	.	195	13	1		.	.	.	.	.
Printing, Stationery, and Journals	.	249	0	6		.	.	.	.	.
Do. Do. Special Circulars, Extra Reports, and Subscription Forms	.	63	11	9		.	.	.	.	.
Fire Insurance	.	29	5	0		.	.	.	.	.
Advertisements	.	30	17	6		.	.	.	.	.
Library	.	84	5	7		.	.	.	.	.
Lecture Expenses	.	12	12	0		.	.	.	.	.
Artificers (Carpenters, Ironmongers, Painters, Glaziers, &c.)	.	117	9	0		.	.	.	.	.
Fixtures in the late Secretary's quarters	.	9	4	6		.	.	.	.	.
Stamps, &c.	.	3	0	0		.	.	.	.	.
Total Ordinary Expenditure	.	£1,736	19	1	Total Income for 1857	.	.	£1,912	11	3
Invested in purchase of £110 19s. 1d. Consols, bought at 90 per cent.	.	100	0	0	Life Subscriptions received during 1857	.	.	.	.	.
Do. do. £165 10s. 4d. do. 90½ do.	.	150	0	0	Do. do. from 1856	.	.	.	.	.
Repaid Three Entrance Fees and Eight Subscriptions, the same having been paid in error by the Agents	.	7	0	0		.	.	.	.	.
Balance of Life Subscriptions in hand for 1857	.	3	2	9		.	.	.	.	.
Do. at Bankers	.	18	12	2		.	.	.	.	.
Total	.	£2,015	14	0	Total	.	.	£2,015	14	0

18th February, 1858.

Examined and found correct,

J. CHARLIER.
J. E. A. DOLBY.
HENRY ELLIOT.
THO. SMITH.

Auditors.

known, when the several corps in the different camps and garrisons received the route for service.

3. Notwithstanding this disadvantage, 176 new Members have joined the Institution during the year ending 31st of December, 1857; while the deaths and withdrawals amount to 164. The names of 48 Members whose subscriptions have been in arrear for four years and upwards, have, in compliance with the laws, (section 6, clause 4,) been removed from the list. The decrease in the number of members is, therefore, 36. A detailed statement of the changes among the Members, and the Tabular Analysis, appears in page 308.

FINANCE.

4. The COUNCIL now submit the General Abstract of the Accounts for the Year 1857, as audited on the 18th of February, 1858. (See opposite page.)

5. The ordinary receipts have exceeded the estimate by £175; thereby effectually covering the deficiency of £92, which had been calculated upon in framing the estimate for 1857.

6. In the Report of last year, the COUNCIL acquainted the Members that Her Majesty's Government had consented to place upon the Estimates an annual grant to the Institution, provided that security was given for the proper application of the sum, and that the advantages the Institution held out were permanent, and such as would justify a grant of public money. The reply of the COUNCIL to these inquiries was considered satisfactory, and Colonel Lefroy, who is a Member of the Institution, and attached to the War Department, was elected upon the Council. A vote of £400 was accordingly proposed by Her Majesty's Government, which received the sanction of Parliament.

7. It has been frequently the duty of the COUNCIL to remark upon the paralysing effect of the heavy rent and taxation, (viz. £490,) upon the resources of an Institution attached to the interests of the Naval and Military Services; and they gladly take this opportunity of recording their acknowledgements to Lord Panmure, the late Secretary of State for War, through whose immediate agency the grant has been obtained, and which has already enabled them, as will be hereafter shown, to improve the scientific departments of the Institution.

8. At the same time the COUNCIL most earnestly impress upon Members their conviction, that, important as this assistance is, it is only upon the exertions, the professional spirit, and the zealous co-operation of individuals, that the Institution can safely rely; and that a dependence upon Government aid would be fatal to its interests, if unaccompanied by self-reliance, and the good-will of the officers of the naval and military professions.

9. The total expenditure of the year has exceeded the estimate by £315; but of this amount £250 was expended subsequently to the receipt

of the grant above adverted to, for the improvement of the Library, in printing the Journal, and in Lecture expenses. There has been an increase in the following instances:—wages, £5, in consequence of the employment of temporary servants during the improvements in the Museum; printing and stationery, £174, £34 of which were for bills of 1856; artificers' work, £66, of which £27 were for arrears of 1856; Library, £34; and £10 for painting and papering the Secretary's quarters. On the other hand, there has been a decrease under the following heads:—Secretary's salary, £38; fuel, £13; lighting, £6 15s.; postage, £15; advertisements, £14; rates and taxes, £20.

10. The undermentioned new items also appear:—£63 11s. 9d. for printing and circulating an address to the officers of the two services, and for extra reports, as recommended in the Report of last year; £20 donation to the clerk for the extra work he performed during the illness of Mr. Tonna; £9 4s. 6d. for fixtures in the Secretary's rooms; and £27 for Income tax, upon the salary of the late Secretary, and upon the wages of the Clerk and head Porter.

11. The COUNCIL have also to remark that they have altogether paid £87 for bills incurred in 1856, which, owing to the state of health of their late Secretary, were not in their hands at the time when the estimate for the expenses of 1857 was drawn up; and there is now a bill of £35 outstanding since 1849, for printing a portion of the Catalogue of the Museum, but which, it is believed, was not brought forward by the late Secretary for payment, in consequence of the work being in progress.

12. In the Report of 1857, the COUNCIL called attention to the excess of the expenditure over the ordinary income in 1855 and 1856, amounting to £164, which was paid out of the Life Subscriptions of those years; and which, according to the established practice of the Institution, should be repaid for the purpose of being invested. The COUNCIL have the satisfaction of informing the Members, that after they received the grant from Government, they invested £150 in the purchase of Stock. They have also invested £100 of the Life Subscriptions received in 1856 and 1857, and the sum which now remains to be invested is £17. 2s. 9d.

The Stock, therefore, now amounts to £1038, 3 per Cent. Consols.

13. The COUNCIL have much pleasure in bringing to the notice of the Meeting, that the List of Members who have augmented their Annual Subscriptions from ten shillings to one pound is steadily increasing, viz., from 92 in 1856 to 106 in 1857 (see page 309). It has been frequently urged upon the COUNCIL that the annual subscription of ten shillings is too small, and that the interests of the Institution would be benefited, if it were raised to one sovereign, even if they lost the support of many of the Members. The COUNCIL have carefully considered this subject, and it is their opinion that it is a great object to obtain the co-operation of as large a number of officers on full pay as possible; that, as so large a portion of the army and navy serve abroad, it could hardly be expected that they *would* be willing to pay an increased subscription during their absence;

and that, as the Institution seeks to be a benefit and a source of interest to the whole military service, no officer should be excluded on account of the amount of the subscription, should he wish to become a Member. Although the Institution has for some years suffered from want of resources, yet the improvements which have recently taken place, and the power which the COUNCIL now enjoys of making it more useful and attractive, have decided them to decline to make this proposal.

14. At the same time they do not hesitate to say, that the voluntary increase of their annual subscriptions by Members is calculated, in the highest degree, to confirm the stability of the Institution; and they earnestly entreat those Members who take a personal interest in its success, who have the opportunity of making use of it, and who value the Journal that is now published, to give the subject their most favourable consideration.

15. The COUNCIL have to express their acknowledgements for the liberal donations which have been received from several of their Members, a list of whom appears in page 310.

16. The following is the estimate of the ordinary Receipt and Expenditure for the year 1858 :—

ESTIMATE OF PROBABLE RECEIPTS AND EXPENDITURE FOR 1858.*

EXPENDITURE.			RECEIPTS.		
	£	s. d.		£	s. d.
Secretary's Salary . . .	150	0 0	Annual Subscriptions . .	1250	0 0
Clerk's Salary . . .	72	0 0	Entrance Fees . . .	150	0 0
Servants' Wages . . .	300	0 0	Dividends . . .	30	0 0
Ditto Clothing . . .	36	0 0	Estimated Income . . .	1430	0 0
Fuel . . .	45	0 0			
Lighting . . .	20	0 0			
Domestic Sundries . . .	20	0 0			
Postage . . .	30	0 0			
Assessed Taxes . . .	100	0 0			
Income Tax for Clerk and					
Porter . . .	5	0 0			
Rates . . .	120	0 0			
Ground Rent . . .	200	0 0			
Printing, Stationery, &c. .	50	0 0			
Fire Insurance . . .	29	0 0			
Advertisements . . .	35	0 0			
Library . . .	50	0 0			
Artificers, Repairs, Casual-					
ties, &c. . .	100	0 0			
Lectures . . .	30	0 0			
Bill for printing Museum					
Catalogue in 1849 . .	35	0 0			
Balance . . .	3	0 0			
	£1430	0 0		£1430	0 0

* The grant from Government is not included in the Estimated Receipts, as it is not yet voted; on the other hand, the expense of printing the Journal, &c., is excluded from the Estimate of the Expenditure.

THE SECRETARY.

17. The COUNCIL regret that it is their duty to record the death of their late Secretary, L. H. J. Tonna, Esq., who had been engaged in the service of the Institution upwards of twenty-one years, during which time the Institution had derived great benefit from his ability and zeal. For the last few years a long and debilitating illness had impaired his efficiency, though he continued to exert himself in the discharge of his duties. After his death, Colonel Alcock kindly undertook the office of Honorary Secretary until a permanent appointment was made.

18. A Committee was appointed to make the necessary arrangements for filling the vacant office. They announced by advertisement the terms and requisite qualifications: viz., that the office be limited to officers who have served in one of the military professions; salary, £150 a-year, with unfurnished apartments and fuel; age, not to exceed 45. Also that security to the amount of £400 would be required. After an examination of the testimonials of 62 candidates, they recommended Captain Burgess of the Indian Army, as duly qualified for the office of Secretary and Curator, and accordingly he received the appointment. The alterations which have since been made in the Institution have required considerable exertion on his part, and the Council have every reason to be satisfied with the choice they have made.

THE JOURNAL.

19. The COUNCIL have now to announce that as soon as Parliament sanctioned the grant proposed by the Government, they decided upon publishing a Journal of their proceedings. They have for years anxiously looked forward to the time when it might be in their power to carry this object into effect, as a means of developing the design of the Institution.

20. The COUNCIL propose to publish three or four numbers of the Journal in each year. The lectures delivered at the Institution, or an abstract of them; the proceedings of evening meetings; a description of the inventions exhibited; illustrated when necessary by maps and diagrams, will be published in the Journal, under the direction and at the discretion of the Publication Committee. A list of the Members who have joined the Institution; a list of Donations, of increased Subscriptions, and of the Presents received, with the donor's name, will also be duly recorded.

21. The COUNCIL seek by means of the Journal:—

1st. To issue to their Members a professional and scientific periodical, useful, instructive, and interesting, worthy of the Institution and the Services, whereby officers of various acquirements may have the opportunity of imparting their information for the benefit of their comrades, by which, research and study will be promoted in some, and through which, information and instruction will be obtained by others.

2nd. To give those Members who are serving abroad, or who are not able personally to attend at the Institution, a full and complete report of its

proceedings, so that they may as far as possible derive a benefit from being Members, and feel an interest in its progress.

22. Three numbers have already been published, and it is confidently expected that they will be found to do justice to the lectures delivered, and be a credit to the Institution. The COUNCIL trust that ere long the Journal may become an important work for the circulation of professional science.

23. The COUNCIL, however, must not disguise from the Members, that in preparing this periodical in the style alluded to, illustrated by maps, plans, and diagrams, they are incurring an expense nearly as great in amount as the grant they receive from Government, a portion of which ought to be devoted to the Library, Lectures, and Model-rooms. While, therefore, the COUNCIL have adopted the course which they think is right and desirable for the interest of the Institution, they at the same time express a hope that the Journal may be an additional inducement to officers of both professions to give the Institution their support.

24. The COUNCIL propose for the present to forward the Journal free of expense to all Members in Great Britain whose addresses are known; and to transmit it to the head quarters of each Colonial station, for officers serving abroad.

THE LECTURES.

25. The Lectures delivered, and the papers read at the evening meetings, last year were of a high order, and by gentlemen of distinguished abilities, upon subjects of great interest and professional utility. As these are now recorded in the Journal, the COUNCIL do not think it necessary to recapitulate them here. When they have so much reason to be grateful to those who have so kindly given their services, it would be invidious to particularize, as their names were a guarantee for the efficient exposition of their subjects; but a Lecture delivered by Lieutenant Walker, a young officer of the Royal Engineers, deserves to be noticed; although little more than a year in the service, he evinced a knowledge of the higher branches of his profession, and explained his subject in a manner that did him the greatest credit.

SEVASTOPOL MODEL.

26. The COUNCIL beg to acquaint the members that a new model of Sevastopol and the South of the Crimea is in course of construction under the superintendence of Colonel Hamilton and the Committee appointed to carry it out. A full account of the circumstances, under which this model has been commenced, appears in No. 1 of the Journal, page 75. That part of the model representing the siege, and the country south of the great harbour and of the river Tchernaya, which had been accurately surveyed by the Royal Engineers, and in part by the Engineers of the Sardinian army, has been in great measure completed.

27. The northern part of the harbour and the country about the Mackenzie heights will shortly be commenced, as the Committee have

290 PROCEEDINGS AT THE TWENTY-SEVENTH ANNIVERSARY MEETING.

received information that the plans of the Russian survey have been transmitted to England, copies of which have been placed at the disposal of the Committee. The COUNCIL congratulate the Members upon the receipt of such interesting documents, so highly conducive to the more accurate completion of the model.

28. In order to defray the necessary expenses of the work, a subscription list was opened; when his Royal Highness the Prince Consort, to whom the Institution is indebted for the suggestion, that a correct model of the position of the Allied attack and Russian defences at the capture of the city should be permanently preserved, added another mark of the kind interest he takes in the Institution by subscribing £50 towards this object.

A List of the Subscribers is annexed (page 311), but the amount as yet contributed falls considerably short of the sum required.

29. The COUNCIL have to express their acknowledgments for the great facilities that have been afforded by Mr. Cole, who granted a space in the Museum of Science and Art at South Kensington, for the construction of the model.

PRESENTS.

30. A List of the Presents received since the last evening meeting is appended, (page 313). Amongst these, the COUNCIL wish to draw special notice to the Plans of the Sardinian Survey of the Crimea, presented by General della Marmora; to the specimens of Percussion Rifles and Muskets, presented by the Secretary of State for the War Department; and to the munificent contribution of Edward Jekyll, Esq., late Grenadier Guards, who has presented a collection of 24 Models of various descriptions of Steam Engines.

VICE-PATRON.

31. The COUNCIL have the pleasure of announcing that Field Marshal the King of the Belgians has become a Member of the Institution during the past year, and has accepted the office of Vice-Patron.

VICE-PRESIDENTS.

32. The COUNCIL have to lament the death of two of their Vice-Presidents during 1857, viz:—Vice-Admiral Lord Radstock, and Rear-Admiral Sir Francis Beaufort. They have elected to that office Lieutenant-Colonel Alcock, to whose exertions, both before and after the death of their late Secretary, they were much indebted, and Captain Ford, who has ever been a most useful and active supporter of the Institution.

THE BUILDING.

33. In the Report of 1857, the COUNCIL informed the Members that they had declined to accept the sum of £750 offered by the Metropolitan Board of Works, in full satisfaction of all claims in respect to the damage done to the building by the operations in repairing the large sewer, and that

they had requested the Board to restore the building to its original condition.

34. The works for the restoration of the building were consequently commenced by the Board on the 6th of April, 1857, their progress has been watched by Mr. Poynter on the part of the Institution, and by Mr. Pennithorne on behalf of the Crown; the rooms are now nearly completed, and Mr. Poynter reports that, from the manner in which the foundations have been laid, he thinks there is no probability of a further subsidence in that portion of the building from the same cause.

THE MUSEUM.

35. Owing to the disturbance produced by these works, the COUNCIL considered that it was a fitting opportunity to clean and paint the interior of the Institution, a step which was much required. They also thought that the time had now come when it was their duty to incur some expense in giving the Institution a more attractive aspect. The COUNCIL would call the attention of the Members to the Waterloo Model Room and Lecture Theatre which have been coloured under the superintendence of Mr. Owen Jones, to whom the COUNCIL beg to express their thanks for his valuable aid.

36. The expense incurred in washing the walls and in painting the great quantity of wood is no more than might be expected from the size of the building, and the nature of its contents; while the additional expense incurred in the rooms above mentioned is only for the extra time consumed by using a variety of colours.

37. The Museum has been entirely dismantled. The cellars and garrets, which were filled with a mass of heterogeneous articles, principally duplicates, have been cleared out: some of these had been there for upwards of twenty years, and consisted of books, skins of birds, geological specimens, and miscellaneous articles from various countries.

38. The COUNCIL considered that it had become positively necessary to adopt a decided policy with regard to the several departments in the Museum, and to establish a principle of action, before they refitted it.

39. During last summer, increased space for the display of military models being much required, it was seriously discussed in the Council, whether the specimens of natural history should be any longer retained. But, as such objects are included in the fundamental laws, it was decided, after consulting Colonel Portlock, a Member of the Council of Military Education, that sufficient space might be obtained for present purposes by removing the larger specimens.

40. In December, however, the circumstances were entirely altered. The re-arrangement of the Museum was about to commence, and there was no space for the contents of the store-rooms. Colonel Lindsay, the Chairman of the COUNCIL, accordingly submitted a memorandum upon the subject, for the consideration of the COUNCIL, which they adopted; they

further decided to call a Special General Meeting to determine upon what principle the re-organisation of the Museum should be carried out.

41. The meeting took place on the 4th of January, 1858 ; when it was decided that in Natural History the system of keeping types of species should be adopted, but that large animals should not be retained or accepted. That in all the departments, duplicates, and such specimens as were not required in the re-arrangement, should be exchanged, or given away to other Institutions, at the discretion of the COUNCIL, reference being made to the donors when practicable. The COUNCIL need hardly add, that the decision of the General Meeting was indispensable, in order to obtain space to exhibit to advantage the treasures collected in the Institution, and to give them a classification which would make them really instructive. The proceedings of the meeting, the Report founded upon the memorandum, and the resolutions adopted, are appended, (page 304).

42. The COUNCIL have carried into effect this decision ; and, in re-arranging the Museum, they have acted upon this principle: that every department should have a distinct object in view, and be made, as far as their means allowed, subservient to an end ; that each should be practical and methodical in arrangement, as far as possible, and conducive to interest and instruction. They have given increased space for the exhibition of naval and military models ; and they have applied to the Admiralty and War Office for such models and implements of war as the Institution is not in possession of. They have also appropriated a room for the establishment of a Topographical and Hydrographical Department.

43. The COUNCIL are anxious to bring to the notice of the Members the laborious and unremitting exertions of the Special Committee appointed to carry out these arrangements. It was found necessary, not only to examine separately each article, but to look over and arrange, according to subjects, all the letters and MS. documents received since the foundation of the Institution, as a means of deciding upon the various details which came before them, and to facilitate a reference to the documents by those Members who wish to consult them.

44. It may however be remarked, that this pressure of business has been, to a great extent, caused by the long-continued illness of the late Secretary ; while the necessity for a re-classification of objects in most of the Departments was chiefly owing to the limited space that the COUNCIL have hitherto had it in their power to assign to them, a difficulty which they have now in part met, and which they hope eventually entirely to overcome.

45. The Metropolitan Board have only recently given over the new rooms, owing to which, and to the necessary consequent delay in commencing some of their operations, the COUNCIL are not able to present the Institution in such a state of complete organisation, in all its departments, as they intended.

46. In addition to the re-arrangement of the Museum, a system of nomenclature has been adopted in every department, which will materially facilitate a reference to any particular subject. The small number of the Mediæval Arms of Europe at present in the Institution has induced the COUNCIL to delay for a time any attempt at a classification of *that* collection, in the hope that it may shortly be increased, by the receipt of specimens both from the Tower of London and from individuals, when a similar system will be adopted to that which is seen in the European, Asiatic, and Chinese Armouries, as well as in the rooms containing the weapons of war of less civilised countries.

47. The COUNCIL will now call the attention of the Members to the present appropriation of the several rooms in the Institution.

The Institution is divided into five different departments, viz. :—

- 1st. The Library and Reading Rooms.
- 2nd. The Military Department.
- 3rd. The Naval Department.
- 4th. The Ethnological Department and the Antiquities.
- 5th. The Natural History Department.

1st. *The Library Department* consists—

- 1st. Of three rooms, containing the Collection of Books and Manuscripts, and the Collection of Coins.
- 2nd. Of a Topographical Room.
- 3rd. Of a Reading Room.

2nd. *The Military Department* is classed under two heads—

- 1st. Military Models, to which three rooms are assigned.
 - 2nd. Arms and Weapons of War, to which six rooms and two galleries are assigned,
- viz. :—

Two rooms to the Weapons of the South Sea Islands, of Africa, of New Zealand, and of Australia.
 One room to the European Armoury.
 One room to the Asiatic Armoury.
 One gallery to Chinese Armour.
 One gallery to South American Arms.
 One room or central staircase to Mediæval Armour, &c.
 One room to Accoutrements and Miscellaneous.

3rd. *The Naval Department* consists of 3 rooms :—

- Nº. 1. Devoted to European Naval Models, chiefly English.
- Nº. 2. Devoted to Foreign Naval Models, chiefly Asiatic.
- Nº. 3. Devoted to Naval Guns, &c., and Naval Relics.

To this department is added the series of models of the Steam Engine, from the earliest periods, lately presented to the Institution by E. Jekyll, Esq., late of the Grenadier Guards.

4th. *The Ethnological Collection* is contained in 1 room, and the small Collection of Antiquities in a gallery down stairs.

5th. *The Natural History* is contained in 2 rooms.

The room, in which is the collection of steam engines, is also appropriated to the exhibition of new patents and inventions, and to the display of all donations to the Institution during one month after their receipt, previous to their being placed in the Museum.

48. The COUNCIL are aware that still much remains to be done towards the complete classification of the Collections they are at present possessed of; and, also, that it is possible that the arrangements now decided on may hereafter require some modification, so as to adapt them to the ever-increasing demands of this Professional Institution.

49. In carrying out the several alterations above referred to, the COUNCIL have received great assistance from the practical experience of Mr. Warrington Smyth, Doctor Livesay, Captain de la Chaumette, and Mr. Gould; and they desire to record their obligations to them. In pursuance of the power vested in them, they have elected Mr. Gould and Mr. Owen Jones Honorary Members; as also Captain Lendy and Mr. Mallett, who have rendered valuable services to the Institution.

50. In cleaning the Institution, and in re-organising the Museum, it has been necessary to incur considerable expense, which will probably amount to £500; but it must be remembered, that, while all other professions have establishments for promoting their peculiar sciences, the noble professions engaged in the service of their country by sea and land have not hitherto possessed an adequate establishment devoted to the advancement of Naval and Military science; it is therefore better to expend the large amount above mentioned than to lose the opportunity which now presents itself of raising the character of the Institution, both in its position as a Museum, and as a means of promoting the progress of professional information.

51. It is the province of this Institution to fill the vacancy which exists in the list of learned and scientific Institutions, among which Naval and Military science has been hitherto unrepresented, and almost unrecognised. Her Majesty's Government has shown a high appreciation of the design by the encouragement which they have given, and the pecuniary support which they have granted. The Special Committee have made every exertion to fulfil their duty at this important juncture; and the COUNCIL believe that, if the course they have adopted receives the approbation of the Members, and if they are able to secure the cordial co-operation of the Officers of the Military professions, the UNITED SERVICE INSTITUTION will take a prominent position as a working Scientific Establishment.

IV. Admiral Sir THOMAS COCHRANE, K.C.B., then moved—"That the Report of the COUNCIL now read be adopted, and printed for circulation amongst the Members."

The motion was seconded by Lieut.-General Sir WILLIAM CODRINGTON, K.C.B., who said,—

I am sure I need not say how full the Report is, what information it gives to every Member, and what very valuable suggestions are contained in it. I hope that Members will increase their Subscriptions, which has been so fairly suggested. It is of very great consequence to keep up the means of meeting the current expenses, independently of the Government grant, thus leaving the Government money to be applied to the purposes to which it has now been devoted, namely, to the lectures and to the book which is printed, which is a most valuable addition to the records of the Society. I do not think there can be any person who has read the pamphlets containing the lectures that can be otherwise than extremely gratified by the good substance which there is, and by the very nice manner in which it is arranged. I therefore beg most cordially to second the Resolution.

The Resolution was put by the Chairman, and carried unanimously.

V. Vice-Admiral BOWLES, C.B., proposed the following Resolution :—
“That the Thanks of this Meeting be given to Lord Panmure, late Secretary of State for the War Department, for the general support he has rendered the Institution, and for having obtained the sanction of Parliament to a grant in aid of its Funds.”

I am sure that no members of the Government can employ their influence more creditably or more usefully than by assisting institutions of this description, and especially by furnishing to the younger members of the joint professions that assistance which they so much stand in need of at the commencement and in the progress of their career, and which this Institution is so well calculated to afford. The specimens of professional models of all sorts, both Military and Naval, and the objects of natural history, will be the means of furnishing them with information which will be of the greatest possible advantage to them.

Colonel SHAFTO ADAIR, Suffolk Militia Artillery, in seconding the Resolution, stated,—

I believe, sir, it is scarcely necessary for me to add anything to what my gallant friend behind me has spoken concerning the merits of my Lord Panmure, and the feeling which this Institution must hold towards him. We find that he has taken an interest in its welfare; and I have been informed since entering the room that this interest has been carried up to the very present moment, and that we are in the receipt this day of a large number of cases from Woolwich, containing objects to be added to the magnificent museum which is now to be opened to the Members.

Sir, in the admirable Report which has been read to you by your Secretary it seems to me that there is a paragraph in connection with this matter on which I may be permitted to say a few words. I refer to the eighth paragraph, in which you will see that, while we thankfully acknowledge the assistance which we have received from official quarters in the establishment of this Institution, still we impress upon our Members that it is to the individual self-reliance of the members of the two professions that the main good of the Institution must be attributed.

My gallant friend behind me has spoken of the advantage that officers will receive from the information contributed to them from this central point in their distant quarters. I also trust that, while at the same time that information will radiate from this point to foreign countries, information will be sent back again from those very quarters. I have no doubt that many officers who have been familiar with our late Indian wars will have remarked how many drafts of operations, maps of the country, highly scientific plans of passes, which hereafter in the career which is opening to us in the East it will be very necessary to be acquainted with, are frequently in the possession of individuals from the want of a common centre. I believe that in most armies of the

Continent there is a general department under the Government in which these things may be deposited. I apprehend that this Institution would be a most fitting receptacle for such documents, and therefore it is, sir, with very great pleasure that I have observed the systematic shape which the operations of the Institution are now taking.

I have, I am afraid, spoken at greater length than I was entitled to as a young Member of this Institution, but I am one who, viewing it from the civilian part of the community, has taken a very great interest in it, inasmuch as I see in this Institution the means of condensing into one focus an amount of information such as probably never was collected by any army or navy in the world, for there is no Institution whose services have been so generally displayed, as there is none in which, I believe, more interest is taken by the members of the professions. I therefore, sir, have the honour of seconding the Resolution.

Colonel LINDSAY said,—

Before the Resolution is put, I wish to say a few words. I think it right upon the part of the COUNCIL to express the obligations they are under to Lord Panmure. When he was Secretary at War, seven years ago, he warmly supported the Institution, and had promised to endeavour to obtain a grant in aid of its funds, when a change in the Government took place. Negotiations were renewed by Sir Howard Douglas and myself whenever there appeared any chance of success; and we have at last succeeded in our efforts, and obtained a grant of £400 a year for the purposes of this Institution. In addition to this, we thought it most desirable that whatever the War Department could give us for the purpose of affording the means of instruction and information should be placed in the Museum, and we accordingly applied for various specimens and models of military machines, material, and implements. Lord Panmure took a liberal view of our application, and we received no less than eleven packages from Woolwich this morning, which we trust are merely the advanced guard of those that we expect from Chatham. By thus giving opportunities of information, I trust we shall be contributing to the general good, not of the military profession only, but of the country at large.

Colonel SYKES, M.P.—

I may be permitted to observe, that I am afraid that if the impression went abroad that the Government grant was a permanent grant, it might probably relax the efforts which are so strongly and prudently recommended for the self-support of the Institution, if it was believed that it was a permanent grant and could be relied upon. Members present, Sir, know well that the Government cannot grant annually any sum whatever—it comes entirely from the annual grant of the House of Commons in the Army Estimates; and the way to secure the permanence of that grant is to satisfy, not only Parliament, but the public, of the permanent good of this Institution. I think that the public mind will be perfectly satisfied upon the Report of the COUNCIL this day, and the manner in which it is proposed by the invaluable Chairman of our COUNCIL to carry the matter out.

The Resolution was put by the Chairman, and carried unanimously.

VI. Colonel DUNNE, in proposing "That the thanks of this Meeting be tendered to Mr. Warrington Smyth, Doctor Livesay, Captain de la Chaumette, Mr. Gould, and Mr. Owen Jones, for the kind advice and assistance they have given to the COUNCIL in the several departments upon which they have been consulted," said—

I may be permitted to say that, having from the time I entered the Service been a subscriber to this Institution, for many years I despaired of success. Lately our indefatigable Chairman, Colonel Lindsay, has done so much that we may rival the Institutions on the Continent. I am perfectly ashamed after what I have seen at Paris. I am sure that their regimental officers are not better than ours, and I do not see why *we should not* be equal to them in publication. If you look back to the early part of

the French Revolution, the years 1763 and 1764, you will find lectures and publications worthy of the most scientific parties. Among others which apply to our own profession, there is a Report of the Black Forest on which Moore founded his retreat. I suppose that no model could be made to surpass that, yet we have nothing in England like it; and when I first had to study my profession, I had to go to foreign countries for that information. I hope the Institution will flourish. I am quite certain that it may become much more efficient than it has been.

Lieutenant-Colonel ALCOCK, of the East Middlesex Militia,—

Mr. Chairman,—As a Member of the Committee, I have had an opportunity of witnessing the exertions of the gentlemen who are named in Colonel Dunne's Motion, which is a vote of thanks to Mr. Warrington Smyth, Dr. Livesay, Captain de la Chaumette, Mr. Gould, and Mr. Owen Jones. I have had an opportunity, almost daily, of witnessing the great trouble and labour which they have had, and the success which has resulted up to the present point, and of which the gentlemen now assembled have an opportunity of judging for themselves. If they could figure to themselves the state in which this theatre was when it was a receptacle for all the duplicates and refuse which came from the galleries and the garrets, and could compare it with the state which it now assumes under the hand Mr. Owen Jones, I think they would carry this Resolution with a great deal of enthusiasm. I have much pleasure in seconding the Motion.

The Resolution was put to the Meeting, and carried unanimously.

VII. Captain FISHBOURNE, R.N., in moving "That the thanks of this Meeting be given to Edward Jekyll, Esq., late Grenadier Guards, for his munificent donation of twenty-four models of steam-engines, which are highly appreciated, both as a valuable addition to the Museum, and as coming from a Member who has already, on previous occasions, shown the interest he takes in the Institution by various contributions of a practical and professional character," said,—

It is hardly necessary for me to say much to induce you, I am sure, to give your thanks, cordially, to Captain Jekyll. It is not only the interest which attaches to the models themselves, and the interest taken by him in the Institution, but the fact that he himself has contributed very largely to the construction of these models. They are of a most valuable character; they extend over a long period, from the time of the first application of steam to motive power by Hero, an Alexandrian philosopher, who lived before the time of our Lord, and they embrace all the principles which have been used in steam, whether as applied to land-engines or to sea-engines. In fact, we may say that we have substantially a type of every class of engine presented to us collected in this munificent donation of Captain Jekyll. It is not only interesting, but highly instructive. Some may imagine that, because of the long period which has elapsed, and because the engine is an old engine, no value attaches to it; but it is not so. This very engine of Hero has been repeated again and again—it has been repeated, for instance, in Ruthven's application of steam in Scotland, and by an individual in America. In these old models the principle is the same, and it suggests ideas; it is instructive; it brings out mechanical intelligence, and it is exceedingly valuable. I have much pleasure in proposing that the hearty thanks of the Members of the Institution be given to Captain Jekyll.

Colonel YORKE, Hereford Militia,—

Mr. Chairman, I have very great pleasure in seconding this Resolution, and I will remark to the Members that this is not the first time that we are indebted to Mr. Jekyll for contributions to the models contained in this Institution. It is not only that we are indebted to him for this very remarkable, and I suppose unique, collection of steam-

engines which has been mentioned by Captain Fishbourne, but we are also indebted to him for a collection of models of the different systems of fortification—a collection beginning with the earliest system of Vauban, and terminating with the late German system. Those models were all constructed by Mr. Jekyll himself, with the assistance of another active Member of our Council now present, Colonel Hamilton.

The Resolution was put by the Chairman, and carried unanimously.

VIII. Major-General Lord ROKEBY, K.C.B.:—

Those Members who have listened to the Annual Report of the COUNCIL will naturally have observed the ground of the Resolution which I am about to have the honour of moving; and after the opinions which have been expressed by those gallant Officers who have spoken, I have not the slightest doubt that you will unanimously accept and vote the Resolution which I shall propose to you. Anybody who has taken the trouble to look at what has been done by the Special Committee, who have undertaken the labour of re-arranging the whole of the specimens and articles of this Institution, will see the complete success which has attended their exertions, and how much the means of instruction will be increased by the judicious arrangement which is in progress. I have the honour therefore to move:—

“ That the thanks of this meeting be given to the Special Committee, viz., Colonel Lindsay, Chairman of the Council, Colonel Hamilton, Colonel Alcock, Major White, Captain Fishbourne, R.N., Captain Jefferson, Mr. W. S. Lacon, Captain A. C. Tupper, and Captain Nolloth, R.N., for their exertions during the last four months in re-arranging the Museum, and for the success which has attended their efforts; and also to the officers and servants of the Institution.”

Vice-Admiral Sir GEORGE SARTORIUS:—

I have much pleasure in seconding this Resolution. It has been always a subject of great regret to me, that an establishment of this kind, so full of elements of the utmost importance for the good of the two professions, has been in the state of comparative neglect in which we have seen it. But a great move has been made in advance. The judgment and good sense which has been displayed in the arrangement now made, I am sure, will remove one main cause why the establishment has not made more advance. The assistance given from the Government, I have no doubt, will contribute very much to its future success; and I trust that the two professions will render a liberal support. I regret very much that the few last years of my life have been so employed in other matters that I could not take a more active part in an Institution which, in my early days, it was always my most earnest desire to see established. But it is now established; it has taken root; and the good feeling which is shown on all sides by the Members, and by the Government, I hope will tend to make it one of the most important, and one of the most useful, establishments which the professions could have, in giving that character of information and education to the Officers which will make them much more useful Members of their profession than they have hitherto been.

Colonel LINDSAY:

As my name is the first mentioned upon the list comprised in the Resolution, and being also the Chairman, not only of the COUNCIL, but of the Special Committee who conducted these operations, I feel that it is right to the Meeting to say a few words before the Resolution is carried. No Chairman was ever better supported as a Chairman than I have been by the Committee who have supported me during four months. The business has been excessively heavy; and I must say that during that time the gentlemen who have helped me in these operations have never flagged for a moment; and I must do them the justice to say, that the Members of the United Service Insti-

tution owe them thanks for the time which they have spent, and the work which they have gone through. We divided ourselves into Committees, for the purpose of conducting this business. The first name that appears after my own is that of Colonel Hamilton, to whom we owe all the nomenclature which has been established. He has exerted himself in preparing that system; and has, also, undertaken the arrangement of the Military Department. The next name which appears is that of Colonel Alcock, who has been good enough to take under his charge, aided by Naval Officers, the topographical and the hydrographical department. Major White has conducted the finance during that period; while Captain Fishbourne, Captain Nolloth, and Mr. Lacon have been good enough to undertake the charge and the arrangement of the Naval Department. Captain Jefferson, and Mr. Lacon, and Major White have also been arranging the whole of the papers of the Museum; while Captain Tupper has been good enough to take under his charge the arrangement of the armoury. The Committee have of course consulted together upon matters relating to all these departments; and it will be a very great satisfaction to us if the arrangements which we have made are such as to meet the approbation of the Meeting which is now assembled here.

Before I sit down, if you will allow me, I will just say a very few words as to what fell from Colonel Sykes, in which I most cordially agree. We should not, as the Report says, depend upon the Government grant; but I hope and trust that the Members of this Institution will, in their several stations, and in the several societies in which they mix, aid and assist this Institution by explaining what its objects are, and by getting their friends to become members. I have had experience in this respect. I have been a great beggar, and I have begged with very great success.

Now, Gentlemen, there is this point to be borne in mind. If you are inclined to become no more than a Museum, nothing is so easy as to do it. You may reduce half your expenditure at once, and having done so you may say, Take a shilling at the doors, people will be glad to come and pay a shilling, they will be glad to see the Museum. But if you have higher motives, if you have higher aspirations, you have the means of carrying them into effect yourselves. It is only to be done by the active co-operation of all our Members, and more particularly by getting the co-operation of the Members who are serving upon full pay. Now I know that there is a difficulty there; the great bulk of officers are serving abroad, or in stations remote from London, and therefore they very naturally say, "Of what use is this Institution to us?" It has been perfectly true. I do not deny it. Our object now is to make the Institution valuable to all; and if we can carry that object into effect by means of the Journal, the numbers of which are now lying upon the table, we hope to carry the Institution to those officers. There is more than ten shillings' worth of information in that book—it is worth the money—and we hope by means of that book to carry the Institution to them, and to get them to come to us, in spirit at any rate, if they cannot do so in person. Now that is the object which the COUNCIL, of which I have the honour to be Chairman, have had, not only in the last year, but in the last two or three years; and I hope that with your co-operation, and that of your friends, you will be able to assist the COUNCIL in carrying this object into effect.

The Resolution was put by the Chairman, and carried unanimously.

IX. The names of Eight Members who retire from the COUNCIL by rotation were read, viz.:—

Captain BAILLIE.
Lord LOVAINE.
Admiral GAWEN.
Sir FREDERICK ABBOTT.

Major Loraine White.
Colonel T. C. Smith.
Colonel Matheson.
Major SUTHERLAND.

X. Colonel RIDLEY:—

Before I propose the Resolution which I have to submit to the Meeting, and which I am sure will meet with the approbation of every person present, I will in a few words express the pleasure which I have felt myself, and which must have been shared in by

everybody, at hearing the Report read of this most valuable Institution. I may say that it is a most satisfactory one, when we consider the very great difficulties under which this Institution has always laboured. My gallant friend who has just been speaking has brought to my mind one occurrence, or several occurrences, which have happened in my experience. The subject of this Institution was more than once mentioned at my own table, when I had the honour of commanding a brigade in the Crimea. I was a beggar, not a very good one, and I am afraid I am not like my gallant friend. I got a few subscribers, but whenever I pressed the matter, the answer which I got was, "It is all very important for the Household Brigade, and for those who are near London, to subscribe to the Institution, but we shall never have the means of seeing it." In vain I endeavoured to convince them, that taking an interest in their profession, for that reason alone they ought to support us. Some of them promised to do so. Whether they have done so I cannot say. I am afraid I did not follow up the matter at once. However, I still hope that we may live to see the day when every one who has the interest of his profession at heart (and I wish that every one had it) will liberally subscribe to the support of this Institution. I beg leave to propose the following Resolution:

"That the Thanks of the Meeting be given to the Members of the COUNCIL who retire by rotation, and that the following officers be elected to fill the vacancies, viz. :—

Major L. WHITE.
Colonel T. C. SMITH.
Colonel T. MATHERSON.
Captain M. S. NOLLOTH, R.N.

} For Re-
election.

Lieut.-Colonel HOGG, 1st Life Guards.
Captain J. GRANT, late R. Art.
Maj.-Gen. Sir FENWICK WILLIAMS, R. Art.
Colonel SNAFFO ADAIR, Suffolk Mil. Art.

The Resolution, having been seconded by Colonel BIGGE, of the Northumberland Militia, was put by the Chairman, and carried unanimously.

It was moved by Captain PACKE, seconded by Colonel PASCHAL, and carried unanimously,—“That the Thanks of this Meeting be given to the Auditors, and that they be requested to continue their valuable services for the ensuing year, viz. :—

JOSEPH CHARLIER, Dep. Ass. Com. Genl.
H. ELLIOT, Esq.
THOMAS SMITH, Esq. Army Agent.

Captain J. E. A. DOLBY, late North York
Rifles.
JOHN CASE, Esq. Navy Agent.

The Chairman announced that the business of the day was concluded.

(Signed)

SIDNEY HERBERT, Chairman.

B. BURGESS, Captain, Secretary.

Rear-Admiral Sir THOMAS HERBERT, K.C.B., having been called to the Chair,

Rear-Admiral Sir GEORGE BACK rose and said,—

Gentlemen, it is my pleasing privilege now to propose that a vote of Thanks shall be given to Mr. Sidney Herbert for the courteous and for the efficient manner in which he has presided at the Meeting this day. It is evident to me that this Society, in its amended state, only requires to be more generally known to be appreciated. Therefore, the advantage of the advocacy of such a gentleman as Mr. Herbert must be manifest to every one. Gentlemen, it would be superfluous in me to eulogise a gentleman

whose great talents and character are so well known to this country—in the language of an old author, it would be “wasteful and ridiculous to excess.” I therefore merely call upon you to give him a vote of Thanks.

Lieut.-General Sir WILLIAM CODRINGTON seconded the Motion.

Mr. SIDNEY HERBERT—

Sir Thomas Herbert, and Gentlemen, I hope you will allow me to say a few words in thanking you for the honour which you have just conferred upon me. You are aware that I owe to the United Services no common gratitude. I stand in the rather peculiar position of having been the financial organ of both services in Parliament during some years, and I am always rejoiced to have an opportunity of expressing the deep feeling of gratitude that I have towards every officer with whom I ever came in contact in either service, for the cordial assistance, as well as courtesy, which I invariably received.

If I may be allowed to say a few words upon the subject of this Institution, and upon its present position, I will endeavour to make them, at any rate, extremely short. This is the first time that I have had the pleasure of attending a Meeting here. I have heard with the greatest satisfaction the details which are contained in the Report, showing how this institution is extending itself in usefulness, and especially how it is assuming every day a more practical character, which will be of the greatest advantage to the officers of both services. I naturally feel a diffidence in addressing upon any subject connected with the two services men who belong to them, I being only a civilian. But, as a civilian, I have some experience at any rate of (if I may use the expression) the status of the two services in public estimation. There is no doubt that the Navy is the popular service in England. I know this, that it is easier to get £1,000 in the House of Commons for the Navy, than it is to get £100 for the Army. Now, certainly, though I mention this as a fact, it is not from any want of appreciation of the merits of the Army that I say it, but I think one can account for the fact. We are a free State, and we are an insular State; and all free States having sea-board have always been a great maritime people. There is a jealousy in this country of a large standing army, which has arisen from our free Institutions, and the evidence which we have seen upon the continent that the large military defences necessary for the independence of those countries have frequently been used, and almost necessarily used, for the repression of free Institutions. That I take to have been the origin of the feeling. That feeling is now more unfounded, and, in my opinion, more absurd, than any feeling can be as applied to England; but the fact is so. The Army has not in the House of Commons the same advantages which the Navy enjoys. Well, but now let me say this: that within the last few years I have remarked a very great change in this respect. The position of the Army has very greatly improved. One advantage you have had—you have had war; and the English people, when war is going on, when danger has been imminent, and when success is fresh, are very grateful to those who have achieved that success, and their interest, if no other feeling, prompts them to do their utmost to increase the efficiency of the service upon which their safety depends. But there is also the prospect still before us of war. We have got, if I may so say, into a war groove; and my belief is, looking at English history, that for some years to come young officers will have much opportunity of acquiring practical experience in their profession.

Now there is another advantage, an advantage which I think has not been sufficiently weighed, which the Army is deriving in the House of Commons, namely, from the re-establishment of the Militia. I was very glad to see to-day one of the resolutions supported by a very zealous and a very able Militia officer. There is no doubt that the feeling towards the Navy has been greatly strengthened in the House of Commons by the presence of a number of men who as amateurs take great delight in all questions of ship-building and the navigation of ships, which of course have regard to the successful construction of the vessels, and to the appointments and seamanship of the Navy. They are, of all men, developing the Navy. They are men to whom the Navy is indebted for the introduction of that larger class of ship which we have had in the last few years. We have not had the same advantage in Parliament of men, not be-

longing to the Military services, but who have a sufficient knowledge of those services to enable them to be useful in a like manner to the Army. We have Yeomanry officers. I am a Yeomanry officer myself, but we are a very dilettanti race compared with the Militia. I am satisfied that the many Militia officers who are members of Parliament, and men enjoying high station and influential position in the country, will be extremely useful as regards the feeling which is entertained towards the Army. They will understand and appreciate the wants of the Army, and the Army will derive great advantage from their assistance.

I am afraid I am speaking at greater length than I ought to do. I might say this: looking at the list of the various subjects upon which Lectures have been given in this theatre during the last year, I am very much struck with the fact that you are certain here to have, as you are certain always to have during peace, the greatest attention paid to everything which concerns the strictly combatant parts of the two professions; that is to say, you have the most scientific lectures upon strategy, upon tactics, upon fortifications, upon engineering, upon gunnery, upon projectiles. But there are subjects which are more difficult than those, and they are more difficult in the constitution of this country. I mean all the questions which concern the feeding of armies, and the sanitary precautions for the purpose of maintaining the life of armies, whether in the field or at home. Now I recollect that some years ago when I was Secretary-at-War, I was extremely anxious to have some opportunity given to the Army of seeing movements in the field, and the feeling at that time was so jealous upon the subject, that when that small camp was formed at Chobham I was persecuted for two or three nights together by a gentleman called a Liberal Member of Parliament, but whose liberality fell short of the cost of two artillery horses, which had been drowned in attempting to carry a gun over a bridge. That was thought so serious a matter, that it was a question whether the advantages derived by the troops from seeing evolutions in the field could be put in competition with the loss of those two horses. That feeling has gone by, and we have now, both in England and in Ireland, large camps, and every means during the summer of officers and men seeing large bodies of troops together. But that other point, of how armies are to be fed, is one which you cannot practice in peace. I suppose there is no country in the world which is under such disadvantage, owing to the advantages which it possesses, as England is in this respect. You can practise troops in fifty thousand ways in the field, as everybody knows, but you cannot make artificial difficulties in order to teach your commissariat officers how to overcome them. In a country so small as this, intersected by railways, with the most enormous sources of supply, with great competition among tradesmen for that supply, I defy you to teach a Commissariat its duties during peace. It is most important, therefore, that these subjects should be kept constantly in view, so that the theory of what we cannot practise should be studied and put forward as much as possible. The Navy, as it has always appeared to me, has an enormous advantage over the Army in this respect, because, I may say, that there is no difference between peace and war to the Naval man. His commissariat he carries with him, his hospital he carries with him. The seaman in war is no worse off in any respect; he is not exposed to greater hardships or difficulties (though to much greater dangers) than in peace. Except that you shoot your guns, and that you have men to shoot at and not a barrel (provided you are not shot at in return), I do not know any great difference between peace and war. But in the Army it is exactly the reverse. The soldier leaves his barrack, he leaves his hospital, he leaves everything, and then he is thrown upon his own resources to try and meet every possible unexpected exigency. The officer who commands has by his resources and his genius to meet these difficulties; he has to supply from resources probably intended for some other purpose the immediate wants of his army. In short, this task is put upon him, that he has to make bricks without straw. For these reasons I trust it will not be thought impertinent in me if I say that I hope that that class of questions will not be omitted from the consideration of the COUNCIL in the Lectures which are to be delivered.

The same remark applies to all those sanitary questions which are of such importance. No armies that I ever heard of (at least there may be instances) have been destroyed by the sword. You have frightful instances of armies having been destroyed by disease. That has occurred almost in our own times. Take the Walcheren Expedition, where the mortality, I believe, was at one period at the rate of something like 900 per 1,000

per annum, taking it in that way. Take again that campaign of Napoleon, in which all Frenchmen tell you that a great army was destroyed by the severity of the climate; but which, if the statistics of the French War Office are to be believed, was an entire invention, in order to cover the reputation of the Emperor, who had sacrificed his army to deficient commissariat arrangements, because, I believe it is a very well known fact, that of that army, which consisted of something over 300,000 men, there were but 55,000 left on the 4th of November, which was three days before the frost began; and so far from the army having been destroyed in the retreat by cold, it was a most masterly retreat, because 40,000 men returned to France, and Napoleon lost but 15,000 men during the great Russian retreat. These are two great signal cases. We have had another case later. During a great part of the Peninsula War, you had, I think, something like 30 per cent. of all the men in hospital, and only $1\frac{1}{2}$ per cent. were there through wounds. Disease has been the scourge of armies from all time. These are the reasons why I think that these things should be considered. We have had a good deal of discussion upon that very subject lately. I must not get upon that which I am afraid is my hobby at this moment, and as to which I have inflicted a ponderous blue book, and which I hope will be taken by the army as I have meant it, namely, as some return upon my part for the kindness which I have received from them; but not upon mine only, for I have been aided by the most scientific and able colleagues that were ever associated with any gentleman who undertook a public inquiry of that kind. I intend it as a present, which I put into the hands of the army as a weapon with which I hope to see them combat all future Chancellors of the Exchequer, and all future Houses of Parliament, in order that they may get those things done which I believe are necessary for their safety and for their convenience. I say that I will not now enter into that subject. Indeed, it would be very dangerous for you to put me upon it, for it is too fresh in my own mind, and my mind is too eager upon the subject, for me to venture to touch it. But we have seen such instances in civil life of late years of what can be done by care in these respects, that we should be insane if we did not attempt to extend the benefits of sanitary science to the Army likewise. It is a new science. It is a science of which the great mass of the civil population are totally ignorant. It is a science on which, I do not hesitate to say, that I believe medical men are ignorant. The fact is, that their business is not prevention, but cure—the business of sanitary science is not cure, but prevention. I see sitting beside me a very distinguished Officer of Engineers, who has given a most extraordinary proof of what can be done; because I believe, that since 1846 the mortality in prisons has been diminished in some cases by one-half, in some cases by two-thirds; and the previous mortality was certainly not the result of want of care, so far as food or clothing went, but it arose simply from a want of care in the construction of the buildings which the prisoners inhabited.

In mentioning these things, I have spoken at greater length than I intended. All I can say in conclusion is, that it has been most gratifying to me to be allowed the honour of assisting at this Meeting to-day. I have made my apology for introducing these topics at all. I may claim the character of a civil connection with the United Services, having been so long engaged in both; and I have gladly availed myself of this opportunity of expressing the deep interest which I take in the welfare of those two services to which the welfare and the honour of this kingdom are entrusted, and of also expressing my personal sense of the many obligations under which I am to every officer with whom I ever came into communication, either in the one service or in the other.

APPENDIX.

PROCEEDINGS AT A SPECIAL GENERAL MEETING.

At a Special Meeting of the Members of the UNITED SERVICE INSTITUTION, held in the Library of the Institution, at Two o'clock, P.M., on Monday, the 4th of January, 1858,

Major-General Lord ROXBURY, K.C.B., in the Chair,

I. The Notice by which this Special Meeting was convened was read.

II. The Report of the COUNCIL was read, as follows :—

SPECIAL REPORT OF THE COUNCIL.

THE Council submit the following Report of the state of the Museum, for the consideration of the Members :—

1. The rooms of the Institution being in an extremely dirty state, the Council decided, early in the month of October, to clean and paint the interior of the building. The Museum has in consequence been dismantled, and the garrets and cellars have been cleared out. A great mass of heterogeneous articles has been thus brought to light, which have for years been stowed away, either as duplicates, or because there was no room for them in the Museum. They consist of library books, many hundreds of birds, several boxes of geological and mineralogical specimens, and miscellaneous articles from various countries, shells, coins, &c.

2. The present period appears therefore to be not only a favourable opportunity, but one in which there is an absolute necessity, for seriously considering, and deciding upon the course which should in future be adopted with regard to the several departments in the Institution.

3. It will be necessary briefly to describe the state of the Museum before it was dismantled for the purpose of cleaning the building.

4. There have been three rooms hitherto devoted to Natural History.

5. The specimens of Geology, Mineralogy, and Conchology, have been systematically arranged to a certain extent, though not marked in a manner so as to convey interest and instruction; but little or no classification of the Zoological specimens appears to have been attempted.

6. In the first small room there has been an indiscriminate mixture of birds, bears, monkeys, snakes, fish, and insects.

7. In the large room horns, skulls, and stuffed beasts, without arrangement or reference to genus. In the drawers of the cases a mixture of minerals, shells, botany, &c. &c., which had been put aside, no doubt, with the intention of adding them to the arranged collection at some future period.

8. In the third room, cases of birds, only partially arranged. While in the back entrance attached to the naval department were to be found the jaws of a whale, and the skulls of Elephants in close proximity to ancient eastern stone inscriptions, the Franklin relics and Burmese gods; in fact, in the department of Natural History, the Institution has been little better than a show, and has not made use of its specimens in such a manner as to contribute towards the instruction of its Members; upon which principle alone this department could be maintained in a professional establishment.

9. Space also forms an important element in the consideration of this question. The Museum has been for some time so crowded as to make it difficult to dispose of articles

which have been of late years presented, and which has to some extent caused the accumulation before adverted to; the collection having outgrown the accommodation. In consequence of this state of things, it had been seriously discussed in the Council, whether the department of Natural History, which in respect to the objects of the Institution ranks in a secondary light, could be maintained to the exclusion of articles more immediately professional; it is however, an element in the fundamental laws of the Institution; the Museum Committee therefore thought it their duty to consult Colonel Portlock, a Member of the Institution, and one of the Council on Military Education, upon the subject. He expresses his opinion that the department should be maintained; that a slight knowledge of Natural History opens out sources of amusement and interest to officers on foreign stations; but he strongly urges a more methodical arrangement.

10. Having thus laid before the Meeting the *general* position of the Museum; it is evident that some clear and decided rule should be laid down as to the mode of conducting it in future.

11. With regard to Natural History, in which the most extensive action of the pruning knife is required, it is not, and *can* not be the object of this Institution to make a collection such as a naturalist would visit for the purpose of pursuing a course of study, and of making himself acquainted with the minute varieties of the different species in creation. The Institution does *not* aim and it has *not* the space to make a perfect collection such as might vie with those establishments solely devoted to that object.

12. In keeping a collection of Natural History, it is impossible that the Institution can attempt to do more than provide for its Members, whose duties call them to every quarter of the world, the means of examining and becoming acquainted with the different types of the various classes by which a taste for that study may be promoted, and the rudiments of information obtained, and through which recreation may be afforded in its pursuit in the field.

13. These remarks can only apply in a limited degree to quadrupeds, for it is clear there is no room for large stuffed animals, particularly for those which may be seen alive or dead at other establishments.

14. The Council will now briefly call the attention of the Members to the manner in which it is proposed to deal with the different departments.

ZOOLOGY.

15. In that part of Zoology which does not include birds or reptiles, it is proposed to get rid altogether of the large stuffed animals, retaining one or two smaller animals of rare and peculiar species; to dispose of the duplicates of skulls, fish, snakes, &c., and retain only single specimens to mark the class. With regard to the horns, of which there are numerous specimens of the same kind, as they are of an ornamental character, to retain so many as are required, and dispose of the rest.

ORNITHOLOGY.

16. In the section of Ornithology, the Council have reason to thank Mr. Gould, the eminent ornithologist, for the kind assistance he has rendered. He has inspected the collection, and the specimens which have been exhumed from the cellars, amounting to not less than 1,500 or 2,000. To add these to the collection is a clear impossibility; many are duplicates, and the finances would not admit of their being stuffed. Mr. Gould has written a Report upon the subject, and has detailed in what manner he would make the collection useful and instructive. The arrangement which he suggests will leave many duplicates, and other specimens which are not duplicates, to be disposed of. It is proposed to carry into effect the classification suggested by Mr. Gould, who has most kindly offered his services to arrange the collection.

REPTILES IN SPIRITS.

17. It is very questionable whether this collection affords any interest to the Members, though they may be a source of curiosity to the visitors: many specimens are more calculated for the College of Surgeons than an Institution of this description. It is proposed to retain those specimens which are types of species.

INSECTS.

18. There is great want of classification in this section. Several boxes were found in the store room. Captain De la Chaumette has been good enough to volunteer his services to arrange this collection, which occupies only a small space. It is proposed to dispose of duplicates.

MINERALOGY AND GEOLOGY.

19. In this section many boxes have been for years stowed away in the cellars, and numerous specimens have been left in drawers unclassified. Mr. Warrington Smyth has looked over the specimens in the cases, and has written a Report on the collection. His time being much occupied, he has employed a student to examine the specimens in the boxes. It is proposed to dispose of all duplicates, and such articles as are of no interest.

CONCHOLOGY.

20. This section was some years ago put in order by Dr. Livesay. There are, however, many duplicates in the several drawers. There is also a collection presented by Lady Colville, which has not yet been exhibited. Dr. Livesay will examine these specimens, and they will be added to the collection. It is proposed to dispose of the duplicates.

NAVAL DEPARTMENT.

21. Captains Fishbourne, R.N. and Nolloth, R.N. have undertaken to report upon this collection, and to arrange for the disposition of the models of steam engines which Captain Jekyll has so munificently expressed his intention of presenting. There are many duplicates among the models of boats, &c. It is proposed to class this collection as far as possible, and dispose of the duplicates.

LIBRARY.

22. A great number of duplicate library books have been found in the garrets; they are chiefly military, and of old date: also old army lists, navy lists, &c. On inquiry at Messrs. Parker's and Messrs. Mitchell's, there appears to be no sale for such books, and that they are little better than waste paper. It is proposed to dispose of them to such members who may wish for them, or to give them to other institutions.

MISCELLANEOUS.

23. The Lecture Theatre is crowded with a mass of heterogeneous specimens from almost every country. They have been arranged by countries as far as possible. It is proposed to keep those which are worth keeping, and which are not duplicates, and dispose of the rest.

24. Having thus given both a general and detailed statement of the state of the Museum, the Council now submit for the consideration of the Members a line of policy which they recommend to be adopted in reference to the Museum, both at present and in future.

1st. That the principle of exchange be adopted in reference to duplicates.

2nd. That such articles or specimens as are of no intrinsic value, either in themselves, or as illustrating a period or habits of a country, that are not types of species, even if not duplicates, be disposed of at the discretion of the Council, should want of space or convenience in classification require it.

3rd. That large stuffed animals be not accepted unless they have taken part in, or been killed in connection with, some professional operation or under some extraordinary circumstance which may give them a character of historical interest.

4th. That the plan proposed by Mr. Gould be adopted with reference to ornithology, skulls, bones, reptiles, viz. the principle of keeping types illustrating distinct species,

and that donations which do not come within this limit be not accepted ; and that articles rendered superfluous by the adoption of this principle be disposed of.

6th. That in case the specific donor is known and is alive, he shall be informed of the intention to dispose of any articles he may have given. But it must be observed that many of the boxes of birds have been in the cellars for from twenty to twenty-five years, and that it is impossible now to say by whom the greater part were presented. The same remark applies to the miscellaneous articles.

25. In conclusion, the Council most strongly urge that the opportunity which presents itself of establishing a decided policy, and of placing the Institution in such a position as to make it worthy of the support of the two services, should not be lost. They submit that *now* is the time to do so, and that to neglect it would postpone for years the elevation of the Institution into a practical working establishment. Every department should have a distinct object in view, and be made subservient to an end. Each should be practical and methodical in their arrangement as a means of information and instruction.

26. In one department, however, the Institution has in 1857 taken a decided step in advance. The Lectures delivered have been of a high order and by gentlemen distinguished for their abilities. The commencement of a Journal recording the proceedings and communicating professional information marks an important era in the existence of the Institution, and from which successful results may be anticipated. It is therefore only the more necessary that a line of policy should be at once adopted which may make each department conducive to the advancement of professional science and to the promotion of general information among the Members.

Having thus explained their views as to the future conduct of the Museum, and the policy which they recommend, the Council now request the opinion of the Members upon the proposals they have submitted for consideration.

Signed, JAMES LINDSAY, Colonel,
Chairman of the Council.

I. It was moved by Colonel MONCRIEFFE, and seconded by Captain BARNETT, R.N.—

That the Report of the COUNCIL be received and adopted.

Carried *nem. con.*

II. It was moved by Major-General ALVES, and seconded by Captain GRANT—

That the COUNCIL be authorised to dispose of and exchange duplicates.

Carried *nem. con.*

III. It was moved by Doctor THOMSON, and seconded by Lieutenant-Colonel BURNABY—

That the COUNCIL be authorised to dispose of or exchange such articles or specimens as are not required in carrying out the more methodical arrangement of the Museum.

Carried *nem. con.*

Signed, ROKEBY, Major-General,
Chairman.

Colonel LINDSAY having been called to the Chair,

Colonel YORKE moved—

That the cordial thanks of the Meeting be given to Major-General Lord ROKEBY for his kindness in taking the Chair.

The Motion was seconded by Captain Sweney, and carried unanimously.

**STATEMENT OF CHANGES AMONG THE MEMBERS SINCE 1ST
JANUARY, 1857 :—**

	Life.	Annual.	Total
Number of Members on the 1st Jan. 1857 .	820	+	2384 = 3204
Do. who have joined during 1857 .	10	166	176
	830	2550	3380
Changed from Annual to Life . . .	+ 3	— 3	
	833	2547	3380
	Life.	Annual.	
Deduct—Deaths during 1857 . .	12	97	
Withdrawals . . .	0	55	
Names struck off for non-pay- ment . . .	0	48	
	12	200	212
Number of Members 1st Jan. 1858 . .	821	+	2347 = 3168

**TABULAR ANALYSIS OF THE STATE OF THE INSTITUTION,
To the 31st of December, 1857.**

Year. 1st Jan. to 31st Dec.	Annual Subs. received.	Entrance Fees.	Income (from all sources).*	Life Subs. received.	Amount of Stock.	Invested in the purchase of Books, &c.	No. of Vols. in Library.	No. of Mem- bers on the 31st Dec.	Number of Visitors.
1831	£ 654	£ ..	£ 654	£ 1,194	£ ..	£ ..	..	1,437	..
1832	1,146	..	1,146	973	..	..	..	2,699	..
1833	1,405	..	1,450	692	..	..	..	3,341	..
1834	1,500	..	1,549	583	1,100	..	..	3,748	13,376
1835	1,480	..	1,574	366	2,430	40	..	4,155	8,537
1836	1,570	..	1,682	330	3,747	45	..	4,069	8,521
1837	1,549	..	1,747	222	4,747	180	..	4,164	10,907
1838	1,462	..	1,634	230	5,500	246	..	4,175	15,788
1839	1,399	..	1,565	168	5,500	292	..	4,186	16,248
1840	1,363	..	1,525	198	5,500	446	5,500	4,257	17,120
1841	1,450	..	1,643	186	6,000	243	5,850	4,243	19,421
1842	1,373	..	1,565	144	6,400	373	6,450	4,127	21,552
1843	1,299	..	1,494	140	6,700	237	7,000	4,078	27,058
1844	1,274	..	1,408	112	3,000	298	7,850	3,968	22,767
1845	1,313	..	1,466	228	1,500	127	8,100	3,988	21,627
1846	1,298	..	1,456	138	1,500	74	8,410	4,031	32,885
1847	1,314	74	1,502	132	1,700	37	..	4,017	38,699
1848	1,175	57	1,375	48	1,700	85	9,641	3,947	37,140
1849	1,176	72	1,375	84	1,150	58	..	3,970	33,333
1850	1,141	106	1,294	198	600	36	..	3,998	33,773
1851	1,136	131	1,292	66	666	34	10,150	3,188	52,173
1852	1,134	133	1,281	114	200	43	10,300	3,078	20,609
1853	1,243	319	1,684	264	528	41	10,420	3,251	25,952
1854	1,200	138	1,368	126	612	95	10,587	3,171	22,661
1855	1,159	107	1,289	120	653	55	10,780	3,131	14,778
1856	1,216	197	1,519	156	761	47	10,832	3,204	16,184
1857	1,258	176	1,337	78	1,038	40	10,960	3,168	12,755

* Including Annual Subscriptions, Entrance Fees, Donations, Legacies, and Interest Property; and also the grant from Government, commencing in 1857.

LIST OF MEMBERS WHO HAVE PAID
INCREASED SUBSCRIPTIONS DURING 1857.

	£	s.	d.		£	s.	d.
Abbey, R., Major, late 72 Regt.	1	0	0	Doherty, Sir R. Major-Gen.	1	0	0
Abbott, Sir F., Col. (ret.) Beng. Army	1	0	0	Douglas, W. Major-Gen.	2	0	0
Addison, J. E. Lt.-Col. Asst. Qua. Mast. Gen.	1	1	0	Doveton, Sir John (K.C.B.) Lt.-Gen. Mad. Army	1	0	0
Ainslie, H. F. Lt.-Col., late 83 Regt.	1	0	0	Drummond, Berkeley Maj.-Gen.	1	0	0
Airey, J. M. C., Lieut., R.N.	1	0	0	Dynevor, Lord G. R. Lt.-Col. Roy. Cum. Mil.	1	0	0
Airey, Sir Richard, (K.C.B.) Maj.-Gen., Qua. Mast. Gen.	1	0	0	Egerton, C. R. Com. R.N.,	1	0	0
Austen, P. Colonel unat.	1	0	0	Finch, Hon. J. (C.B.) Lt.-Gen., Col. 24 Regt.	1	10	0
Aylmer, F.W., Lord, (K.C.B.) Admiral	1	0	0	Fonblanque, J. S. M. Lieut. h.p. 21st Fus.	1	0	0
Back, Sir Geo., Rear-Adm. R.N.	1	0	0	Fraser, Hon. A. E. Maj. Sco. Fu. Gds.	1	0	0
Bagnold, Michael Maj.-Gen. Bomb. Army	1	0	0	Gage, Hon. H. E. Maj. Roy. Sussex Mil.	1	0	0
Baillie, J. Capt. 26 Bengal N.I.	1	1	0	Gardiner, T. Esq. late Purser H.E.I.C. Serv.	1	0	0
Barrow, J. Esq., F.R.S. late Admiralty	1	0	0	Gascoigne, E. F. Maj.-Gen.	1	1	0
Bayly, V. T. Lieut. 54 Regt.	0	15	0	Gawler, G. (K.H.) Col., late 52 Regt.	1	0	0
Beaufort, Sir F., (K.C.B.) Admiral	2	2	0	Gleig, Rev. G. R. (M.A.) Chaplain-General	1	0	0
Belgians, His Majesty the King of	2	0	0	Goodwin, E. Capt. Cambridge Militia	1	0	0
Bell, W. H., Lieut. 3d Lt. Drs.	1	1	0	Gordon, Sir J. A., (G.C.B.) Adm.	1	0	0
Bentinck, Sir H. J. W. (K.C.B.) Lieut.-Gen.	1	0	0	Gordon, Robert Capt. R.N.	1	0	0
Beresford, Rt. Hon. Wm. late Major	1	0	0	Gore, Montagu Maj. North Som. Yeo.	1	0	0
Berkeley, E. S. F. Lieut. 2nd Life Gds.	1	0	0	Grafton, A. Lt.-Col. (ret.) Bomb. Army	0	15	0
Bethune, G. R. D. (C.B.) Rear-Adm.	1	0	0	Grant, J. Capt. late R.A.	1	0	0
Bowles, Sir Geo. (K.C.B.) Lieut.-Gen.	1	0	0	Greene, Godfrey T. Lt.-Col. (ret.) Beng. Eng.	1	0	0
Brien, C. R. Surgeon R.N.	1	0	0	Hallet, C. W. Esq. Navy Agt.	1	0	0
Bruee, Hon. Rob. Col. Gr. Gds.	1	0	0	Hamilton, F. W., (C.B.) Col. Gr. Gds.	1	0	0
Bunbury, H. W., Lt.-Col., Dep.-Adj.-Gen	1	0	0	Hardinge, Lord Maj. Kent. Mil. Art.	1	0	0
Burton, Wm., Col. Beng. Army	1	0	0	Hardy, W. N. Capt. R.A.	1	0	0
Cameron, D. A. Major-Gen.	1	0	0	Hatton, E. H. F. Capt. Northampton Mil.	1	0	0
Carr, R., Capt. Royal Marines	1	0	0	Hindmarsh, Sir John (K.H.) Admiral	1	0	0
Cartwright, H., Col. Gren. Gds.	2	0	0	Hunter, W. Esq. (M.D.) late Colds. Gds.	1	0	0
Chapman, F. E. (C.B.) Col. R.E.	1	0	0	Ingram, A. H. Capt. R.N.	1	0	0
Cooke, W. B. late Lieut. 85 Regt.	1	0	0	Jefferson, R. Capt. h.p. Cey. Reg.	1	0	0
Dacres, Sir R. J. (K.C.B.) Major-Gen. R.A.	1	0	0	Knollys, W. T. Maj.-Gen.	1	0	0
Damer, S. L. D. Capt. Sco. Fus. Gds.	1	0	0	Law, Hon. H. S. late Capt. 28 Regt.	1	0	0
Davidson, Jno. Surgeon (ret.) Beng. Army	1	0	0	Lightfoot, T., (C.B.) Lieut.-Gen., Col. 62 Regt.	1	0	0
Dixon, W. Capt. Q. O. L. I. Militia	1	0	0	Lindsay, Hon. James Col. G. Gds.	2	0	0
				Lindsay, R. J. Capt. Sc. Fus. Gds.	1	0	0

	£	s	d.		£	s	d.	
MacGrigor, R. G.				Smart, Robert	Capt. R.N.	1	0	0
Maj. ret. Beng. Art.	1	1	0	Smith, H. P. late Lt. Rif.-Brig.		1	0	0
Money, Rowland, (C.B.)R.-Ad.	1	0	0	Stanhope, P. S.	Maj.-Gen.	1	0	0
Monius, Eaton	Maj.-Gen.	1	0	Stephenson, F. C. A.				
Monteith, W.				Lt.-Col. Sc. Fu. Gds.		1	0	0
Lieut.-Gen.(ret.) Mad. Army	1	0	0	Stovin, Sir F.(K.C.B., K.C.M.G.)				
Mundy, G. C.	Colonel unat.	1	0	Lt.-Gen.		1	0	0
Newdigate, F. W.				Stuart, J.F.D.C. Lt.Col.Gr.Gds.		1	0	0
Lt.-Col. Colds. Gds.	1	0	0	Sykes, W. H. (F.R.S.)				
Nicolson, Sir F. W. E. Bt.				Col. (ret.) Bom. Army		1	0	0
Capt. R.N.	1	0	0	Taylor, H. G. A. (C.B.)				
Oke, C.W., Lieut. R.N. (K.W.)				Lt.-Gen. Mad. Army		1	0	0
for 1857 and 1858	2	0	0	Taylor, T. Col.(ret.)Beng. Army		1	0	0
Paget, Fred. Col. late Clids.Gds.	1	0	0	Taylor, T. M.	Maj.-Gen.	1	0	0
Pennington, Hon. J. F.				Thompson, G. F. Col.(ret.)R.E.		1	0	0
Capt. Rifle Brigade	1	0	0	Thomson, Harry				
Rabin, W.Lt.-Col.(ret.) 22 Regt.	1	0	0	Lieut.-Gen. Ben. Army		1	0	0
Radstock, Lord, G. (C.B.)				Twemlow, Geo. Col. Beng. Art.		1	0	0
Vice-Adm.	1	1	0	Vacher, F. S. Bt.-Maj. 33 Reg.		1	0	0
Raper, H., (F.R.A.S.) Lt. R.N.	1	0	0	Walker, G.A. Capt.Dumf.Mil.		1	0	0
Riley, Spenser H. Esq. Adm.	1	0	0	Wildman, J.	Col. unatt.	1	0	0
Rokeyby, Lord H. (K.C.B.)				Wilford, E. C.				
Major-Gen.	1	0	0	Lt.-Col. School of Musketry		0	10	0
Rooke, C. A. Esq.				Wrottesley, Hon. Geo.				
late Lt. Hon. Art. Comp.	1	0	0	Capt. R.E.		1	0	0
Sabine, E. (F.R.S.)M.-Gen.R.A.	1	0	0	Wynne, W. Lt.-Col. Colds. Gds.		1	0	0
Scott, Sir Sibald D. Bart.								
late Capt. Sussex Art. Mil.	1	0	0					
				Total		£111	18	0

DONATIONS

RECEIVED DURING 1857.

	£	s.		£	s.
Alcock, T. St. Leger			Ligertwood, T. Staff-Surgeon	0	10
Lt.-Col. Roy. East Midlax. Mil.	1	0	Lindsay, Jas. Col. Gren. Gds.	10	0
Aylmer, H. Lt.-Col. R.A.	0	10	Macdonald, A.		
Beaufort, Sir F. (K.C.B.) Admiral	10	10	late Lt.-Col. 68 Regt.	1	0
Bell, C. W. Lieut. 15 Huss.	3	0	Monro, D. A. late Maj. 16 Lanc.	1	0
Carter, W. G. Esq. (F.R.S.)			Packe, E. late Capt. R. H. Gds.	1	0
Solicitor Colds. Gds.	1	1	Pollock, Sir George, (G. C.B.) Gen.	1	0
Cust, The Hon. Sir Edward			Ramsden, Sir J. W. (M.P.)		
Maj.-Gen.	1	0	Under Sec. of State for War.	14	0
Dobie, R. Surgeon, R.N.	1	0	Shirley, H. Maj.-Gen.	5	0
Jefferson, R. Capt. h.p. Ceylon Regt.	1	0			
Lee-Jortin, H. W. Esq.					
late 2nd Life Gds.	1	0			
					£53 12

LIST OF SUBSCRIBERS

FOR THE

CONSTRUCTION OF THE MODEL OF SEVASTOPOL.

FIELD-MARSHAL H.R.H. THE PRINCE CONSORT £50 0 0

	£	s.	d.		£	s.	d.
<i>Sir</i> Roderick Murchison, F.R.S.	5	0	0	Major-Gen. Angerstein	3	0	0
General Stanhope	3	0	0	Major-Gen. Douglas R. E.	3	0	0
Colonel <i>Hon.</i> J. Lindsay				Major-Gen. <i>Sir</i> Charles Pasley,			
Grenadier Guards	2	0	0	K.C.B. R. E.	2	10	0
His Grace the Duke of Norfolk	10	0	0	Captain Manning	1	1	0
Colonel F. W. Hamilton, C.B.				Colonel Matheson	2	0	0
Grenadier Guards	2	0	0	Colonel P. S. Yorke	1	0	0
Colonel Douglas Pennant	25	0	0	Col. Upton, C.B., Coldsm. Gds.	3	0	0
Captain <i>Hon.</i> George Wrottes-				Colonel Cartwright, Gren. Gds.	2	0	0
ley, R.E.	1	0	0	Lt.-Colonel Haygarth			
Major-General Breton	2	0	0	Sco. Fusr. Gds.	1	0	0
Major-General <i>Sir</i> Henry Ben-				Lt.-Colonel Neville			
tinck, K.C.B.	5	0	0	Sco. Fusr. Gds.	1	0	0
General Sutherland	1	0	0	Colonel Clifford Gren. Gds.	1	0	0
Captain Packe, late R. H. Gds.	1	0	0	Colonel Wood Gren. Gds.	5	0	0
Major Patterson	1	0	0	Captain Henry Hamilton	0	10	0
Maj.-Gen. <i>Sir</i> Wm. Codrington	5	0	0	Captain Keppel	1	0	0
Lt.-Col. Stuart Gren. Gds.	2	0	0	<i>Sir</i> Stephen Lushington			
Captain John Ford	1	0	0	R. N.	1	0	0
Col. Ridley, C.B. Gren. Gds.	1	0	0	Lt.-Colonel Wilford	0	10	0
Lt.-Colonel Moorsom				Captain Robert Hamilton			
Sco. Fusr. Gds.	1	1	0	Gren. Gds.	1	0	0
General Earl of Beauchamp	10	0	0	Captain R. Jefferson	2	0	0
Lt.-Col. Tipping Gren. Gds.	2	2	0	Captain J. Grant H.P.R.A.	2	0	0
Maj.-General Dupuis R. Art.	2	0	0	Colonel Bigge			
Gen. <i>Sir</i> William Gomm, K.C.B.	3	0	0	Northumberland Militia	1	0	0
Gen. <i>Sir</i> George Pollock, G.C.B.	5	0	0	Captain Edw. Barnett	0	10	0

LIST OF NEW MEMBERS

WHO HAVE JOINED BETWEEN THE 15TH JULY (THE DATE OF THE
LAST EVENING MEETING) AND THE 31ST DECEMBER, 1857.

LIFE MEMBERS.

Norton, R. T. L., Lieut., Gren. Guards.	Ramsden, Sir John D., Bart., Under Sec. of State for War.
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ANNUAL SUBSCRIBERS.

FIELD-MARSHAL THE KING OF THE BELGIANS, K.G.

King, Thos. Hynde, Lt.-Col., Gren. Gds.	Bingham, A. B., Lieut., 11th Hussars.
Malton, W. D., Lieut., Royal Middlesex Rifles.	Stewart, D. S. " "
Corbet, E. A., Lieut., Shropshire Militia.	Shells, F. C. " "
Yonge, G. N. K., Major, Depot Battalion.	Garnett, A. P., Cornet " "
Burgess, A. F., Commander, Royal Navy.	Tempest, A. C. " "
Jones, W. P. d'Allington, Ensign, 4th Royal Middlesex Militia.	Stewart, J. A. " "
Cheaney, F. R., Major-General, Royal Artillery.	Mossley, P. P. " "
Legge, Hon. E. H., Lieut., Coldstream Guards.	Somers, R. J. " "
Fraser, Daniel, Colonel, ret. full pay, 42nd Royal Highlanders.	Robinson, G. C. " "
Flowden, C. H. C., Esq., Board of Control.	Anthony, P., Vet. Surgeon "
Cumberland, C. E., Capt., Royal Engineers.	Watson, Thomas, Lieut.-Colonel, Madras Army.
Lempriere, G. R., " " "	Maclean, P., Lieut.-Col., Royal Artillery.
Locock, Herbert, Lieut. " "	Fonblanque, H. B. de, Asst.-Commissary- General.
Lowry, R. W., Lieut.-Col., 47th Regt.	Burr, Edwd. Thos., Esq., Admiralty.
Fitzroy, C. C., Capt., 68th Light Infantry.	Herbert, Henry A., Lieut., Coldstream Guards.
Brooke, E. B., Colonel, 67th Regt.	Seymour, W. F., Lieut., Coldstream Gds.
Hope, C. W., Commander, Royal Navy.	Blamire, Charles, Capt., 99th Regiment.
Campbell, James, Capt., 1st Royal Artil- lery.	Hennell, L., Colonel, ret. Bombay Army.
Miller, James, Captain, 11th Hussars.	Hood, W. H., Commander Royal Navy.
Trevelyan, H. A. " "	Harrison, J. M., Lieut., Hon. Artillery Company.
	Chamberlayne, J. C., Lieut., half pay Royal Artillery.

ADDITIONS TO THE LIBRARY AND MUSEUM

SINCE THE 15TH JULY, 1857—(continued from Page 279).

LIBRARY.—BOOKS.

(The Donors' Names in *Italics*.)

- AGRICULTURAL SOCIETY OF ENGLAND (The Royal). Their Journal, Vol. XVIII. Part 1, No. 39. 8vo. Lond. 1857.
The Society.
- AMERICAN CATALOGUE OF BOOKS: or, English Guide to American Literature. 8vo. London, 1856.
Sampson Low, Son, and Co.
- ANDREWS (W. P.) F.R.G.S. &c. Letter to Lord Palmerston, K.G., on the Political Importance of the Euphrates Valley Railway, and the Necessity of the Financial Support of Her Majesty's Government. *Maj.-Gen. Chesney, R.A.*
- ANTIQUARIES (SOCIETY OF). *Archæologia*, Vol. XXXVI., Part 2., and Vol. XXXVII., Part 1.
Proceedings, 43 to 46.
List of Fellows for 1856-1857.
The Society.
- ART UNION OF LONDON. Report of the Council of the Art Union of London for 1857, with List of Members.
Ditto, ditto, unbound.
Four Art Union Almanacs for 1858.
The Society.
- ASTRONOMICAL SOCIETY (The Royal): Their Monthly Notices, Vol. XVI. 1855-56.
Memoirs of the Royal Astronomical Society, Vol. XXV. being the quarto half volume for the Session 1855-56.
Greenwich Observations, 1855.
The Society.
- ASTRONOMICAL OBSERVATIONS made at the ROYAL OBSERVATORY, EDINBURGH. Vol. XI. for 1849-1854.
Charles Piazzi Smyth, Esq., Astronomer Royal.
- BANISTER (T.) Esq. Our Military System at Home and Abroad; in a Letter to the Duke of Cambridge. Pamph. 8vo. London, 1857.
The Author.
- BARROW, (J.) Esq. F.R.S. Summer Tours in Central Europe, 1855-56. Part 3.
A Tour on the Continent by Rail and Road in the Summer of 1852.
Summer Tours in Central Europe, 1853-54.
Ditto, ditto. Part 2.
(Published in the *Traveller's Library*.)
The Author.
- BEECHER (Capt. A. B.) The Landfall of Columbus; or, his First Voyage to America.
The Author.
- BIDDLECOMBE (G.) Esq. R.N. Steam Fleet Tactics.
The Author.
- BODIE (J.) Esq., Master, R.N. Observations on laying Telegraphic Cables in the deep Sea. Pamph. 8vo. London, 1857.
The Author.
- BOMBAY Magnetical and Meteorological Observations, 1854, 1855.
Hon. E. I. Company.
- BRITISH ASSOCIATION. Report of the Twenty-sixth Meeting of the British Association for the Advancement of Science. 8vo. Cheltenham, 1856.
The Society.
- BURNABY (Major), Gren. Guards. A few Short Demonstrations on the Advantage of employing a British European Legion in India. Pam. Large folio. London, Sept. 1857.
Is it beneath the Dignity of a Nation to Employ Foreign Soldiers? Pam. 8vo. London, 1857.
The Author.
- CHESNEY (Major-General). London to Lahore; or, the Euphrates, Scinde, and Punjab Railways.
The Author.
- The Euphrates Railway the Shortest Route to India.
Highways to the East.
European Interest in Railways in the Valley of the Euphrates.
- CLARKE (Hyde), Esq. Colonization, Defence, and Railways in our Indian Empire. 8vo. London, 1857.
The Author.
- CUST (Major-Gen. Hon. Sir Edw.) Annals of the Wars of the 18th Century, 1739-1759. Vol. II.
The Author.
- DRESS REGULATIONS for the Army, 1857.
The Queen's Regulations and Orders for the Army, 1857.
The Adjutant-General.
- ENGINEERS (Royal). Papers on subjects connected with the Duties of this corps. New Series. Vol. VI.
The Editors.
- FABLES (Major-General). The only Approved Guide through all Stages of a Quarrel.
The Author.

- FONBLANQUE (Edward Barrington de). Money or Merit; the Army Purchase Question considered with especial reference to the recent Commission of Inquiry. 1857.
Charles Skete, Esq.
- EDINBURGH (Royal Society of). Their Proceedings. Session 1856-57.
Their Transactions. Vol. XXI. Part IV. For the Sessions 1856-57.
The Society.
- GARDINER (Sir Robt.) K.C.B. Question of Legislative Military Responsibility. Three Copies. *The Author.*
Cursory View of the present Crisis in India, together with the Military Power of England. 8vo. London, 1857.
The Author.
- GEOGRAPHICAL SOCIETY (The Royal). Proceedings of the Royal Geographical Society of London. No. 11.
The Society.
- HIGGINS (W. F.) Esq. The Royal Navy Men's Advocate. 8vo. London, 1757.
Army List, 1764. 8vo. London.
List of His Majesty's Royal Navy. (Manuscript.) *The Author.*
- LENDY (Capt.). Maxims, Advice, and Instructions on the Art of War; or a practical Military Guide for the use of Soldiers of all arms, and of all countries. Translated from the French by Capt. Lendy. 12mo. London. 1857.
The Translator.
- LIFE BOAT JOURNAL (The). Vol. III. Nos. 25, 26, 27. *Life Boat Institution.*
- MALTON (W. D.), Lieut. 2nd Royal Mid. Militia. Company and Battalion Drill Illustrated. *The Author.*
- ORDENNAZ MILITARE. 1815. 2 Vols. *Maj.-Gen. Falls.*
- RAPER, Lieut. R.N. Practice of Navigation. *The Author.*
- REGULATIONS for the Provision of Clothing, Necessaries, Appointments, and Accoutrements for the Army. Pam. 8vo. London, 1857.
Secretary of State for War.
- RENNIE (G.) Esq. On the Quantity of Heat developed by Water when violently agitated, &c. Pamphlet. *The Author.*
- RICORDO PITTORICO Militare della Spe-dizione Sard in Oriente.
The Sardinian Government.
- ROYAL INSTITUTION OF GREAT BRITAIN. Catalogue of the Library of the Royal Institution.
Notices of the Meetings of the Members. Part 7. Nov. 1856-July 1857.
A List of the Members, Officers, &c., With the Report of the Visitors for the Year 1856. *The Institution.*
- ROYAL SOCIETY (Proceedings of the). Vol. VIII. No. 27. *The Society.*
- SCIENTIFIC CORPS. Two copies of the Report of the Commissioners on the Reorganization of the System of Training Officers for the. *Lord Panmure.*
- SOWERBY (James) F.L.S., &c. A New Elucidation of Colours, original, prismatic, and material, showing their concordance in three primaries, Yellow, Red, and Blue, and the means of producing, measuring, and mixing them, with some observations on the accuracy of Sir Isaac Newton. 1 vol. 4to. Lond. 1809. *Capt. B. Burgess, Sec.*
- TAYLOR (Rear-Admiral), C.B. Defence of the Coast of Great Britain, and other most important matters. *The Author.*
- TORONTO (Canada), Observations made at the Magnetical and Meteorological Observatory at. Vol. III., for 1846, 1847, 1848. *H. M. Government.*
- UNITED STATES COAST SURVEY for 1855, Report of the Superintendent of.
- UNITED STATES MAGAZINE. Vol. IV., No. 3. *Col. S. Colt.*
- VACHER's Parliamentary Companion. 12mo. London, 1857. *The Publisher.*
- WARRE, Animadversions of. 1639.
Major-Gen. Bagnold.
- ZOOLOGICAL SOCIETY Proceedings. Part 24 of 1856.
Proceedings for 1857. Page 1 to 112.
Ditto. Page 113 to 192.
Transactions. Vol. IV. Part 4. *The Society.*

MAPS, PLANS, AND CHARTS.

- 103 New Charts.
10 Corrected ditto.
20 Books and Pamphlets.
Lords Commissioners of the Admiralty.
- Chart of Utrecht, Holland.
Maps of the course of the Scheldt, with the frontier of Flanders and Brabant, 1789.
W. F. Higgins, Esq.
- Plans of Dunkirk from the year 646 to the 31st December, 1768 (Manuscript).
Atlas de l'Itineraire descriptif de l'Espagne, par Alexander de Laborde.
Mr. Wyld.
- Plan of the Siege Works at Delhi.
Plan of Lucknow, bound and coloured.
Secretary of State for War.

DRAWINGS AND ENGRAVINGS.

View of Sunbury Practical Military Col- lege.	Portrait of Lieut. Bellot, late French Navy.
<i>Capt. A. F. Lendy.</i>	<i>J. Barrow, Esq.</i>

ARMORY.

1 Brunswick Rifle, with rammer and sword-bayonet.	1 Rifle, short pattern, with rammer and sword-bayonet and steel mounted scabbard, 1856.
1 Musket, with rammer and bayonet, back-action pattern, 1838.	1 Lancaster Carbine Rifle, with ram- mer and sword-bayonet.
1 Musket, with rammer and bayonet, smooth-bore pattern, 1839.	1 ditto ditto, N. P., with rammer and sword-bayonet, artillery.
1 Musket, with rammer and bayonet, smooth-bore pattern, 1842.	1 ditto ditto, Sharpe's breech-load- ing short barrel.
1 Serjeant's Fusil, with rammer and bayonet, smooth-bore, 1842.	<i>Secretary of State for War.</i>
1 Serjeant's Fusil, with side-pieces	Improved Cartouch Pouch.
1 Victoria Carbine, with swivel rammer.	<i>Rear-Admiral J. N. Taylor, C.B.</i>
1 Musket, rifled pattern, with jagged rammers and bayonets, 1842.	A pair of South-American Spurs.
1 ditto ditto, 1851.	<i>Col. Tucker, R.E.</i>
1 ditto ditto, 1853.	

MUSEUM.

NAVAL DEPARTMENT.

Piece of the timber of the Russian man- of-war "The Twelve Apostles," sunk in Sevastopol Harbour.	Portion of the Atlantic Telegraph Wire.
<i>Spencer Ponsonby, Esq.</i>	<i>Messrs. Glass, Elliott, and Co.</i>

MEDALS AND COINS.

Roman Coin found near Chelsea, supposed to be of one of the younger Emperors of Constantinople.	Crimean Medal, with clasps.
<i>By J. Ewen.</i>	South African Medal.
	Baltic Medal.
	Arctic Medal.
	<i>Master of the Mint.</i>

NATURAL HISTORY.

1. Fruit of the Coco-de-Mer of the Sey- chelles Islands, Indian Ocean, distant dependencies of the Island of Mauritius.	2. Salmon caught with rod and line in the River Ness, in February, 1857, by General Sutherland.
	<i>Lieut.-General Sutherland.</i>

MINERALOGY.

Specimens from the site of the Conflagration at Gateshead :—

1. Sulphur which appears to have flowed in a liquid state through apertures into water.
2. Sulphur and Soda mixed.
3. Sulphur and Lead mixed, forming a Sulphuret of Lead.
4. Piece of a Stone infiltrated, when hot, with Sulphur.

5. Piece of a Stone infiltrated, when hot, with Sulphur.

6. Ditto ditto.

7. Piece of Charred Wood, the cracks and pores filled with Sulphur when liquid, similar to the infiltration of petrified wood.

8. Piece of Wood encrusted with Sulphur.

Col. Tucker, R.E.

ETHNOLOGICAL.

A large Book, written on Palm Leaves, lacquered and gilt (Cambodian).

A Book of Guadama.

A Cingalese Book.

A Siamese Book.

Mr. C. G. Johnston, R.M.

Rottee Cap of Palm Leaf, made at Coepang by Solgai Vasha, baptized Daniel, native of the Island of Rottee, near Timer.

T. Baines, Esq.

MISCELLANEOUS.

Two Danger Signals for Railway Passengers. *Captain J. Norton.*

NOTICES TO MEMBERS.

CANDIDATES.

1. The following Officers have a right to become at once MEMBERS of the UNITED SERVICE INSTITUTION WITHOUT BALLOT, upon paying their Entrance Fee and Annual Subscription, viz.—

Princes of the Blood Royal; Officers of the Navy, Army, Marines, Yeomanry, Militia; East India Company's Land and Sea Forces; Lord Lieutenants and Deputy Lieutenants of Counties.

2. CANDIDATES LIABLE TO BE BALLOTTED FOR.—Retired Officers; Civil Functionaries who are, or have been, attached to the Naval and Military Department; Navy and Army Agents; and Candidates for Commissions above the age of fifteen, whose names are on the List of the Commander-in-Chief for Commissions in the Army.

SUBSCRIPTION.

1. An Entrance Fee of One Pound on joining the Institution.

The payment of a sum of *not less* than SIX POUNDS, in addition to the Entrance Fee, constitutes a Member for Life.

The Annual Subscription shall be *not less* than TEN SHILLINGS, due on the 1st of January each year.

2. When a Member joins the Institution on or after the 1st of October, he will not be charged the Annual Subscription on the following 1st of January, but it will become due in the subsequent January, fifteen months afterwards.

ADMISSION.

1. Members serving abroad, or non-resident in the United Kingdom, are entitled to an Absent Member's ticket, which will admit

their friends to see the Museum. The name and address of the person in whose charge this ticket is given must be transmitted to the Secretary and appear on the ticket; which must be renewed at the commencement of every year.

2. The Museum is open from 11 to 5 in summer, and 11 to 4 in winter. Printed tickets for the admission of parties can be had on application to the Secretary. These tickets are available every day except Fridays, on which day Members only can personally introduce their friends.

3. Members can admit two friends to the Lectures and Evening Meetings; either by *personally* introducing them, or by tickets, which can be procured from the Secretary, except upon special occasions, when due notice will be given.

4. The Institution will be closed to visitors the last week in the months of June, September, December, and March.

5. Soldiers and sailors in uniform are admitted without tickets to see the Museum, Fridays excepted.

6. Inventors and Patentees, whose inventions are placed in the Exhibition Room, may have a limited number of tickets for the admission of their friends, on personal application to the Secretary.

THE JOURNAL.

1. Members of the Institution are entitled to receive the Journal free of charge, so long as the funds admit of it.

2. New Members are not entitled to receive the numbers of the Journal published before they join; but they, or other persons wishing to purchase the early numbers, can obtain them from Messrs. Mitchell, the publishers to the Institution, near the Admiralty. The price of each number is two shillings.

3. For the present, the Journal will be sent, free of expense, to all Members in Great Britain whose addresses are known, or who signify their wish to receive it; and it will be transmitted to the head-quarters of each Colonial station for Officers serving abroad.

4. When each number of the Journal is ready for delivery, it will be advertised in the professional papers and in the 'Times.'

MUSEUM.

In consequence of the very limited space in the Institution, and of the decision of the General Meeting held on the 4th of January, 1858, the following are the rules under which presents will be in future accepted; and the Council now point out those objects which they think most desirable for the collection.

1. In zoology, the system adopted being that of keeping types of species, the Council will, at some future period, state the various specimens which they may be anxious to obtain to complete the series.

2. Large stuffed animals cannot be accepted, unless they have some connection with a military operation, or have some remarkable or historical interest.

3. The Council are anxious to improve the collection in the following departments:

ARMOURY.—Arms of all nations in early and present times; armour of different periods; arms of distinguished warriors of all countries.

MODELS.—Military works, naval architecture; naval and military machines; implements of war.

INSTRUMENTS OR MODELS OF THE SAME.—In use for nautical astronomy; for geographical position; for military surveying.

TROPHIES AND RELICS.—Colours; standards; arms or other articles captured in action; or whatever may be of interest in illustrating the services of the navy and army.

MAPS AND PLANS.—Surveys of officers; information as to fresh discoveries; alterations in harbours, forts, &c.; which may be useful to officers proceeding to foreign stations.

LIBRARY.—Works relating to naval and military science and history; geography; travels and voyages; statistics; natural philosophy; mathematics; mechanics; astronomy; chemistry, &c. &c.

The Council trust that Members who publish will favour the Institution with a copy of their work.

4. When presents are received which are duplicates, or that do not come within the limitation determined on, and the donors are serving abroad, they will be taken care of by the Secretary until the pleasure of the donors shall be made known as to their future disposal.

5 The Council are anxious to afford inventors of articles of a naval and military character every facility for the full exhibition of their inventions; and will, on the recommendation of the Museum Committee, place it in their collection. If, however, space requires it, or if the invention becomes no longer available, the owner will be written to, to request his instructions as to its disposal.

6. The Council earnestly solicit communications from officers upon all branches of knowledge connected with both professions. They are anxious to receive information from officers serving in the field, respecting details of operations, topography of countries, the effect of naval and military appliances, suggestions for improvement—such information to be read at the Evening Meetings by the Secretary.

7. Information respecting the Institution will be advertised in the "Naval and Military Gazette," "United Service Gazette," "The Wellington Gazette," and "The United Service Journal;" and notices of Lectures and Evening Meetings will be sent to the Clubs in London.

Officers wishing to become members of the United Service Institution may fill up one of the subjoined forms,—tear out the leaf, and enclose it to the Secretary:—

FORM FOR BECOMING AN ANNUAL SUBSCRIBER.

185

It is my desire to become a Member of the United Service Institution; and I hereby request and authorise my Agent [or Banker], Messrs. _____, to pay my Entrance Fee and Annual Subscription now, and as it becomes due on the 1st January in each year, to the Secretary of the Institution.

Signature.

Qualification
for Membership.

FORM FOR BECOMING A LIFE SUBSCRIBER.

It is my desire to become a Life Member of the United Service Institution; and I hereby authorise my Agents [or Bankers], Messrs. _____, to pay my Entrance Fee and Life Subscription to the Secretary of the Institution.

Signature.

Qualification
for Membership.

Entrance Fee—not less than ONE POUND.

Annual Subscription—not less than TEN SHILLINGS.

Life Subscription SIX POUNDS, in addition to the Entrance Fee.

Officers in India may pay their Subscriptions to Messrs. Gillander and Co. Calcutta; Messrs. Arbuthnott and Co. Madras; or Messrs. Remington and Co. Bombay.





